The Drills of the Arlberg Tunnel.

Written for ENGINEERING NEWS.]

BY GEO. J. SPECHT, C. E., SAN FRANCISCO, CAL.

(*Concluded from page 29.*)

The Arlberg tunnel, as well as the whole Arlberg railway, is constructed by contract. The main points of the contract of the Arlberg tunnel are as follows:

From the first day of February, 1881, the daily progress of the bottom header on the East side has to be at least 10.8 ft. The completed portion of the tunnel must at no time be more than 180 days behind the face of the bottom header, so that the entire tunnel, including the gravelling of the road bed, will be completed at the 180th day after the meeting of the two headers. (It was estimated that this would take place in the middle of the tunnel, and the tunnel would be opened for traffic about the middle of August, 1885.)

For each day the tunnel is finished after that date the contractor has to pay a penalty of $324, while for every day the tunnel is finished sooner, he will receive a premium of the same amount.

These penalties or premiums will be actually accounted for at each monthly settlement.

The progress in all the other sections of the work in the tunnel must also be at least 10.82 ft. per day. The face of the top header must never be more than 328 ft behind that of the bottom header; and the total length of the unfinished tunnel, simultaneously under construction, shall never be more than 1,965 ft.

The graveled and finished road-bed of the first kilometer (0.62 miles) on either side must be turned over to the government railroad engineers 30 days before either half of the tunnel is completed. The remainder has to be so turned over, that 40 days after the day of the acceptance of the first kilometer the track can be finished in the whole tunnel.

If at any time any one of the sections of the work in the tunnel should be more than 1,000 ft. behind the programme, the contract ceases and the tunnel will at once be constructed at the expense and risk of the contractor by the Imperial department of railways.

The contractor is responsible for the consequences of ordinary and extraordinary accidents. Only in case of war or epidemic he is entitled, under certain conditions, to extra compensations, the amount of which, considering only the actual additional expenses accrued to the contractor, is fixed alone by the government.

Although the Imperial department of railroads reserves for itself a leading influence upon the system of working the tunnel and upon the mechanical department, the contractor is responsible for its success. The contractor is obliged to have a previous understanding with the government about the additions and alterations to be made to the installation. He has to make estimates and specifications thereof, to solicit bids from manufacturers, etc. The Imperial department then makes from time to time an agreement with him, taking his estimates and specifications as a base. Such additional work has to be done by the contractor, paid for by the government; after it is finished, the Imperial department inspects the same, accepts it and turns it over to the contractor for his use free of charge, until the tunnel is finished. The finished sections of the tunnel are to be examined and the accounts for them settled in the first week of January of each year.

The contractor guarantees his work for two years. The securities deposited by the contractor, $243,000, will be returned gradually in installments, but only to such aggregate amount, that never less than $121,800, shall remain in the hands of the government. The entire installation—all the necessary machinery, buildings pipe-lines, etc., etc.—whether they are procured with or without assistance from the contractor—remain the property of the government, and are only loaned to the contractor for use during the construction of the tunnel, free of charge.

It was agreed that the first installations should be completed at the expense of the government until the additional amount so expended would have reached the sum of $194,250 for the East header and $202,500 for the West side. (When the contractor commenced work the aggregate amount expended by the government for the installations was $255,000.) Any savings on the above amounts belong to the government, in addition to its rights as proprietor of the entire installation. The contractor has to provide, at his own expense, all the tools, tracks and switches, boarding-houses, all draft-animals and the necessary stables for the same, all arrangements for storing dynamite, etc.

The following prices were made the base for the contract:

The price of one running meter of tunnel in the first kilometer from each month is taken as the base; for each following kilometer a certain price is added to the one of the proceeding kilometer. The prices are:

1. Bottom header, first kilometer, $75.00 per meter, ($22.90 per ft.)

Additional price for each following kilometer, $5.00 per metre, ($1.53 per ft.)

2. Top header, first kilometer, $50.00 per meter, ($15.25 per ft.

Additional price for each following kilometer, $2.50 per meter, ($0.76 per ft.)

3. All the other work, as enlargement, masonry, arching, etc., but excluding masonry of sub-drain, is classified according to the kind and thickness of the masonry, etc., into ten different types, with different prices, of which the following are the most important ones:

Type No. 1.—No masonry or arching, but sufficiently large excavation to give room for a masonry lining 1.64 ft. thick, first kilometer, $200 per running meter, ($61.10 per ft.) Additional price for each following kilometer, $10.00 per meter, ($3.02 per ft.)

Type No. 2.—With arch and abutments in range rubble masonry, 1.64 ft. thick, no invert, first kilometer, $295.00 per running metre, ($90.00 per foot.) Additional price for each following kilometer, $15.00 per running meter, ($4.50 per foot.)

Type No. 6.—With arch 2.78 ft. thick and abutments 3.6 ft. thick and invert 2.13 ft. thick in ranged rubble masonry, first kilometer, $545.00 per running meter, ($166.00 per ft. Additional price for each following kilometer, $25.00 per running meter, ($7.62 per foot.)

Type No. 10.—With arch 2.95 ft. thick, abutment 4.1 ft. thick and invert 2.62 ft. thick in cut stone masonry, first kilometer, $815.00 per running meter, ($248.50 per ft.) Additional price for each following kilometer, $35.00 per running meter, ($10.68 per ft.)

Prices for the sub-drain, 2.62 ft. high, in the clear and with clear widths varying from 1.97 ft. to 2.62 ft. to 3.28 ft. are respectively $2.44, $3.03 and $3.65 per one running ft. in the first kilometer, with additional prices of $0.15 per running ft. in each following kilometer.

The estimates were as follows:

For the East half	$2,413,842
For the West half	2,441,503

Mess. Lapp & Ceconi were the successful bidders with 5 per cent. addition to the estimate on the East half and 2 per cent. to the West half, making the final cost as follows:

East half	$2,534,532
West half	2,490,333
	$5 024,865

According to the final estimate the total cost of the tunnel including the gravelling of the road bed will be $6,777,780, or $201 per running ft., this depends largely, however, upon the amount and kind of masonry yet to be done.

Cost of installation up to Dec. 31, 1881, at which time the same can be considered as nearly completed.

East side, St. Anton.

1. Grading and roads	$ 8,003.07
2. Water-power, (weirs, pipes, flumes, etc)	57,904.13
3. Machines: 2 turbines, 4 compressors, temporary ventilation consisting of a locomotive and fans, the first installment of drills consisting of 14 drilling-machines, 2 carriages, 400 drills, etc., 6 water pressure engines, 5 compressors, 1 air-reservoir, 4 water-pressure engines, 4 blowers, all the necessary pipes and accessories	161,499.49
4. Buildings	74,640.26
Total	$302,046.95

West side at Langen.

1. Grading and road	$ 14,131.64
2. Water-power, (weirs, pipes, flumes, etc.)	85,396.82
3. Machines: 1 turbine, 4 pumps, 2 accumulators, temporary ventilation, first installment of drills consisting of 3 carriages, 6 hydraulic drills with the necessary drills rods and 200 drill-bits and all accessories, 3 turbines, 8 pumps, 2 accumulators, steam engine of 80 horse-power as reserve, with 22 boilers, definitive ventilation consisting of 1 turbine, 2 sets of ventilators, all the necessary pipes and accessories	120,996.12
4. Buildings	78,308.47
Total	$298,833.05

Total for both sides together $600,880.00

The meeting of the two advance headers of the Arlberg Tunnel, is a most interesting and important event. The unprecedented rapid progress, which was 2.6 times as great as that in the Mont Cenis, and nearly double that in the St. Gothard Tunnel, and the proper following of the enlargements and the arching, decide beyond doubt the question, which has been agitating the minds of the tunnel-engineers for many years past, especially in consequence of the St. Gothard Tunnel, where the advance header was laid in the highest point of the cross-section—whether to drive the advance header as top or bottom header. It may be mentioned here, that M. Bridel, the chief engineer of the Gothard R. R. as well as his immediate predecessor, the now deceased W. Hellwag, pronounced both in favor of the bottom header.

The connecting drill-hole was bored on the third anniversary of the beginning of machine-drilling. Therefore, the progress made in three years was 32,242.4 ft. or per day, an average of 29.52 ft., which has never been done before, anywhere. The survey showed a deviation of the center line of 0.65 ft., which, however, was determined immediately after the connection, only by plumb-lines, without any instruments. The level was absolutely correct, while the length was between 19 and 20 feet shorter than the one determined by triangulation. This is a rather interesting fact, as the same difference had been observed at the Mont Cenis and St. Gothard tunnels.

The following table shows the state of all the different divisions of the tunnel on the day of connection:

Table showing the work done, and yet to be done on November 14th, 1883.

	East Side.	West side.	Together, 33,650.9 ft. Header driven from east portal 2,414 ft. more than from West portal; therefore, point of connection 1207 ft. west of middle of tunnel. Difference in total length, 23 ft. Together, 31,488 ft. Remains to be finished 2,136 ft. Total length of top-header, 33,593'.
Bottom header finished	18032.5 ft.	15618.4 ft.	
In per cent. of whole length	53.6 per ct.	46.4 per ct.	
Of this were made by hand labor	693 ft.	741 ft.	
Top-header finished	17,614 ft.	13,844 ft.	

	East Side. Finished.	West Side. Finished.	Total.	Balance to be Finished.
Enlargements length	15,724 ft.	12,057 ft.	27,788 ft.	5,783 ft.
Enlargements excavations underground	421,820	425,000	846,820	180,500
Masonry, length	15,049 ft.	11,240 ft.	26,289 ft.	7,375 ft.
Masonry, cu. yds.	117,800	138,800	256,600	117,800
Tunnel completed	15,080 ft.	11,340 ft.	26,420 ft.	7,144 ft.
Invert	2,387 ft.	8,100 ft.	10,487 ft.	about 3,940 ft.
No. of men employed	2,000	2,000		

Total of excavation	1,027,320 cu. yds.
Total of masonry	374,400 "
Total of mass to be moved	1,401,720 "

Appendix.—Experience with the Brandt drill at the Sonnstein Tunnel in Austria. The Sonnstein Tunnel is 4690 ft. long. The contract to finish the same, called for a very short time, therefore two lateral drifts were run from the mountain side, so furnishing four additional working faces. It was commenced entirely by hand-labor. But after 2030 ft. were finished, it became apparent that the tunnel could not be completed in time. The rock encountered was an exceedingly hard and close dolomite and lime-stone. The contractor, therefore, concluded to put on a Brandt hydraulic drill. This was in Jan., 1877; April 11, same year, the machine-drilling commenced. The motor in this case was a steam engine 9 in. x 9 in., with two boilers capable of furnishing 20 or 30-horse power. This was, however, somewhat too small; in fact two drills could only be furnished with sufficient power by forced firing. Two double-acting pumps were driven by this engine, making from 65 to 85 revolutions, when one drill was running, and from 150 to 200 revolutions for two drills. They had to deliver water under a pressure of from 1250 to 1765 lbs. to the square inch. This entered an accumulator. The pipes leading the water from that point to the drills were lap-welded, 1¼ in. diameter to the final branch pipe, after that they were 1¼ in. and finally, near the drill, 1 in. The total length of the pipe was 1970 ft. and the velocity of the water carried, from 2.46 to 3.28 ft. per second. The loss by friction and other causes was determined by a manometer to be 73 to 176 lbs., which with an initial pressure of 1250 lbs., is of very little consequence.

The drill column had a weight, when filled with water, of 308 lbs. The diameter of its piston was 6 in. and of the piston-rod 5¾ in. The drilling-machine itself weighed 264 lbs. The diameter of the piston was 4¾ in. and that of the piston-rod 4 in. With a pressure of 1100 lbs. per square inch, the forward pressure forcing the drill against and into the rock, was equal to 13,400 lbs. The drill-bit had an exterior diameter of 3.15 in. and had five teeth, each ⅞ in. wide. The above pressure was distributed upon these five teeth, each of which exercised a total pressure of 2680 lbs, or 393 lbs. for each one-sixteenth of an inch of its width.

The two hydraulic motors turning the drill, used about 530 gallons of water per one hour drilling. Only one drill was used in the face of the heading. On an average it made 1¼ in. of a 3¼ in. wide drill-hole per minute in hard, uniformly solid lime-stone. The face of the header had an area of 70 square feet and required only from three to five drill-holes, each about 4 ft. 3 in. deep. It took, on an average, three hours to drill these holes. The average progress of the drift per 24 hours was 6.7', and per one attack 1.87 ft. One running foot of heading required from 13 to 17 lbs. of dynamite. The average time required for one attack was 5 hours and 45 minutes, of which the drilling took 2 hours and 45 minutes. The wearing off of the drill-bit was slight. The 944 ft. of drift made by these machines at the Sonnstein Tunnel required not more than 80 drill-bits altogether, none of them, after four months use, were so much ground off that they could not be used again. The repairs of the machines proper were practically none, as the driving of the 944 ft. of drift did not require any other repair than the replacing of a few packings in the moving parts.

The making of a bore-hole of 3¼ in. diameter and 4 ft. 3in. deep, required on an average 56 minutes, *i. e.*, from the beginning of the actual drilling to the completion, in which the drill bit had to be renewed from three to

four times. The pressure can be so well regulated that the different hardness of the rock does not affect it at all, as it does in a percussion drill, where the sudden meeting of a soft seam only too often breaks the machine For experimental purposes, the drill was worked through cavities in the rock without the slightest damage to the machine or interruption of the operation. The drill-bits were never heated, as the water playing around them cools them and cleans the hole very effectively. From two to three men were needed to run one drill.

The total cost for the entire installation, including everything, was as follows:

1. Grading	$ 872.00
2. Machine department, boilers, feed-pumps, engines, pumps, accumulator, centrifugal-pump, ventilator, lathe, and a complete set of tools, also labor of setting up	5,625.00
3. Four hydraulic drills, complete with all accessories	4,800.00
4. Pipes	2,775.00
5. Freight, duty, salaries and miscellaneous	1,600.00
Total	$15,672.00

The cost of one running foot of heading, including proportion of first cost (but allowing a sum of $5,875 to be deducted from this first cost, realized by the sale of the machinery) was as follows:

1. Proportion of first cost	$10.30
2. Cost of the machine-drilling and ventilation	9.62
3. Other work in heading (blasting, removing debris, timbering, etc	12.90
Total	$32.82

or one cubic yard of excavation cost about $12.70. This was the first railway tunnel in which the Brandt drill was practically tested—with the exception of a few experiments made previously in the Pfaffensprung tunnel of the Gothard R. R

Pfaffensprung Tunnel. This tunnel, is one of the circular tunnels (see ENGINEERING NEWS, No. 45, Nov. 10, 1883) and is driven through very hard granite. The first experiments made in this tunnel, in the winter 1876-77 and attended to by myself, showed at once the correctness of the principle of this drill. Evidently moved by personal reasons the directors of the Gothard R. R. did not see fit, to encourage this invention. But the far-seeing contractors of the Sonnstein tunnel, having heard of these experiments and comparing them by our own personal inspection with the working of the percussion-drills in the St. Gothard tunnel, were at once convinced, that the Brandt hydraulic drill was the right thing. I shall not give an account of these first experiments, as the latest improvements on the drill make them only of historical value. The Pfaffensprung tunnel was worked from both ends, at first with a top-heading and later with a bottom heading. The lower heading was worked by machine-drills, while the upper one was driven by hand. The machine employed was at first the so-called Frochlich drill, a percussion drill of European design which, however, could not make sufficient progress to finish the tunnel in time. I refer for further details about these to the above mentioned number of ENGINEERING NEWS, and give the following additional notes. The rock encountered was exceedingly hard to drill, requiring a pressure on the hydraulic drill of from 1,250 to 1,395 lbs. per sq. inch, but blasted pretty well. The cost of the entire installation for the Brandt drills including drills and extra parts, was $8,000. Average time occupied by drilling to make

one meter of heading	4 h. 12 m.
Average time occupied by blasting, removing dirt cut	5 h. 24 m.
Number of drill-holes for one meter of heading made	6.6
Total length of drill-holes for one meter of heading made	21.6ft
Number of drills sharpened for one meter of heading made	26.4
Lbs. of dynamite used for one meter of heading made	41.5
The cost of one meter of heading was as follows:	Proportional cost of installation $8.00
Running expenses and maintenance of installation	2.40
Wages	8.78
Dynamite, fuse and caps	12.80
Total cost of one meter of heading including proportional cost of installation	$31.98

One drill-bit made on an average 0.82 ft. of drill holes, without requiring sharpening. Each attack advanced the heading from 2 to 4 ft., according to the ground. Hardly any repairs on the machine were necessary, 2,127 ft. of heading being run by two machines in 371 days (including all delays); average progress per day 5.73 ft.

The average cost of one meter of heading made by the percussion drills was $59.24 against $31.98 when the tunnel was driven by the hydraulic drill.

Mines of Freiburg. "Beihilfe Erbstolten" in Freiberg, Saxony, the percussion and Brandt drills were used and the following results obtained:

	Percussion drills.	Brandt drills.
Mechanical labor employed	1,458,328 m. klg's.	1,164,490 m. klg's
Cross-section of heading	40.29 feet.	37.29 feet.
No. of holes for one attack	33.9	6.2
Total length of holes	84 feet.	22 feet.
Cost of one running foot of heading	$8.01-9.13	$7.72

In one minute 1¼ in. of a 2¾ in. drill-hole was drilled by the Brandt drill in hard gneiss.

Other Mines:—In the mine "Rheinpreussen," the progress made by one Brandt drill in a double-track cross-cut was 312 ft. per month.

In the mine "Nothberg," the average daily progress was 8.5 ft. made by one drill.

In "Bleiberg," when natural pressure was obtainable the cost per one running foot of cross-cut was $4.23, while in "Freiberg," when steam-power was used to run the pumps, the cost was $3.83. In another mine the lowest price of one foot was $2.28 and the highest $13.41.

The cost of running the cross-cut from the Albert shaft in the "Planensche Grund," in Saxony (face 80 square feet) through porphyry was $3.83 against $14.85 per running foot when run by hand-labor.

The Brandt hydraulic rock-drills are now used at a great many mines and tunnels all over Europe, and continue to give great satisfaction.

Temporary Timber Trestle at Grand Rapids.*

The summer of 1883 was remarkable for a succession of freshets which occurred about four weeks apart during the month of May, June and July.

At and near Grand Rapids, on the 21st, 22d and 23rd of July, a succession of rain storms occurred, in which the rain fall was much in excess of anything before known at this season of the year, in that section.

Previously the Grand River was at high water mark from the constant rains. Above 700,000 logs were in the river above the dam, at Grand Rapids, the van resting on and held back by the piers of the Detroit, Grand Haven & Milwaukee Railway bridge. These logs were secured by booms, ropes and chains fastened to the bridge piers and extending across the whole width of the river, thereby damming it back to the height of three feet at the rear end of the logs. From Monday until Thursday morning the piers sustained this tremendous pressure.

The superstructure consisted of five iron-plate girders of 100 feet span each, 10 feet deep and 10 feet wide from centre to centre of beams, and two shore end spans, 60 feet long. These girders rest upon six cribs, which in turn stood upon six sub-cribs, all filled with cobble stone and securely framed together, having ice breakers and everything necessary to withstand any ordinary freshet.

When the booms eventually gave way three of the long girders were canted off the piers and carried down the river, and two of the upper pier swept away. This left a gap of 300 feet which had to be bridged before trains could again cross the river. A temporary trestle was determined on as the only way by which traffic could be resumed in a reasonable time.

The difficulties encountered however were very great. The water was 15 feet deep, the current very strong, many logs were still running, and the bed of the river was rock, covered with boulders. The 100 feet at the east end was bridged with 20 feet spans, double bents and two double stringers 12"x12". This however was found to be very slow in erection, and setting the bents very difficult on account of the boulders.

A change of plan was determined on. This consisted in placing two timber cribs between the sub-piers of the old bridge and erecting thereon in single bents, thus making spans of the unusual length of 34 feet. These were bridged with four double stringers each consisting of one piece of 12"x12" and one of 12"x16", placed on top of one another.

The temporary timber cribs require special mention. They consisted of four mudsills 12"x12"x40" placed parallel to each other and about three feet apart. On the top of these was spiked a 3" plank deck which formed the bottom of the crib. On the top of this again was placed the first course of timber of the crib consisting of two end pieces 12 feet long, and two longitudinal pieces 28 feet long, the ends of the latter butting up to the sides of the former; these four pieces were securely bolted through to the mudsills. On top of this course was spiked a number of cross-ties of 3" plank placed about 6 feet apart, and then a second course consisting of two end pieces 9'6" long, and ten longitudinal pieces 30 feet long, the ends of the former butting up to the sides of the latter thus breaking joint with the course below—was drift-bolted to the lower course and the ties. This second course was the same length as the first, but 6" narrower. Each succeeding course was made 6" narrower than the preceding one and to break joint with the one below, and in this manner were built up to the required height and then filled with cobble stones.

The whole structure was put together with the intention of saving the timber as much as possible, that it might be available for subsequent use.

This latter plan worked admirably and may prove of use in similar cases hereafter.

The first bent was raised on the 30th of July; on the 10th of August traffic was again resumed.

*Paper by Geo. Masson, Chief Engineer Detroit, Grand Haven and Milwaukee Ry, read at the E. Saginaw Meeting of the Michigan Association of Surveyors and Civil Engineers.

DANCHELL'S ELECTRIC RAILWAY.

London *Times*: An electric railway differing in several respects from ordinary electric railways, has been invented by Mr. F. Hahn Danchell, chief engineer, and is being exhibited by a working model at the office of Messrs. Bauer & Co., No. 6 Union Court Chambers, Old Broad street. The main object of the inventor is to obtain a high rate of speed with a light load, and this system has been specially designed for the transport of letters, parcels, and light weight goods. The distinguished feature in the construction is that the train runs on one rail only instead of two, and it is balanced by another rail overhead, which is embraced by pairs of side guide-wheels attached to the upper part of the train. This upper rail is made to act as the conductor of the electric current from the generating station, the current being transmitted to the driving machinery on the engine, which runs upon a pair of central groved wheels of large diameter. The object of this construction is to reduce friction to a minimum, and thus to facilitate the attainment of high speed, which Mr. Danchell proposes should be from 150 to 200 miles per hour. The speed attainable will, of course, depend chiefly on the power that can be attained from the motor. The working model consists of a circular railway about eight feet in diameter, the engine being about twelve inches long by eight inches high, and the power being furnished by an ordinary bichromate battery. The speed attained is very great, and Mr. Danchell states that experiments on a much larger scale have already been carried out to Maidstone. He proposes primarily to supply the system to the transmission of letters and parcels—in fact, for postal purposes, for which it would appear to be adapted.

Iron Cross-Ties on Railroads.

In Germany, at the end of 1881, some 3,606 miles of road were constructed with iron sleepers instead of wooden cross-ties. Of this road 2,264 miles had longitudinal and 412 miles laid with transverse iron sleepers. Germany has used iron as a substitute for cross-ties much more extensively than any other country, and apparently with satisfactory results, as renewals are largely made with iron, the whole length of the new road constructed in 1881 being much less than the increase in road with iron sleepers, and the statistics show that there was a decrease of the ordinary road with T-rails on wooden cross-ties amounting to 198 miles, and also a decrease of 53 miles in rails laid with chairs on wooden cross-ties. There are still 268 miles of road in Germany laid on stone supports, and 16 miles of such road were laid in 1881.

Iron does not seem to be used to any extent for this purpose elsewhere, except in Holland. Experiments were made in Belgium several years ago with some of the German systems, especially with a view to giving work to the suffering iron manufacture of that country, but they seem not to have been satisfactory, and we hear nothing more of the use of iron for that purpose there, though, as iron is perhaps cheaper in Belgium than anywhere else in the world, and it imports its ties, it would seem that it is one of the most promising fields for the use of iron. Timber is not costly there, however, as it is brought from Baltic and North Sea ports at little cost for freight. It is somewhat remarkable that England should have been preceded by Germany in the extensive application of iron for this purpose. It will be noticed that though there is more road on longitudinal than on transverse iron sleepers in Germany, the increase in 1881 was greatest in the latter.—*Railroad Gazette,*

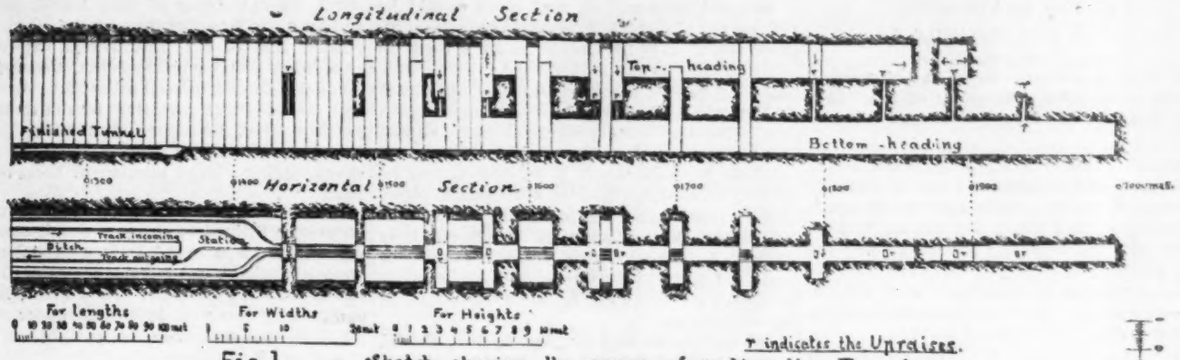
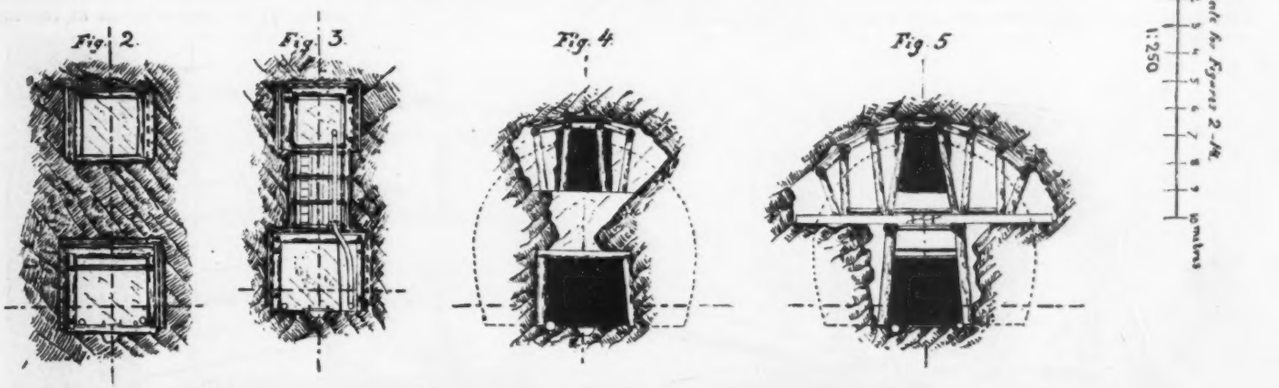
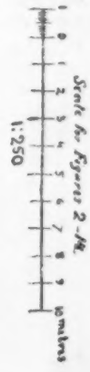
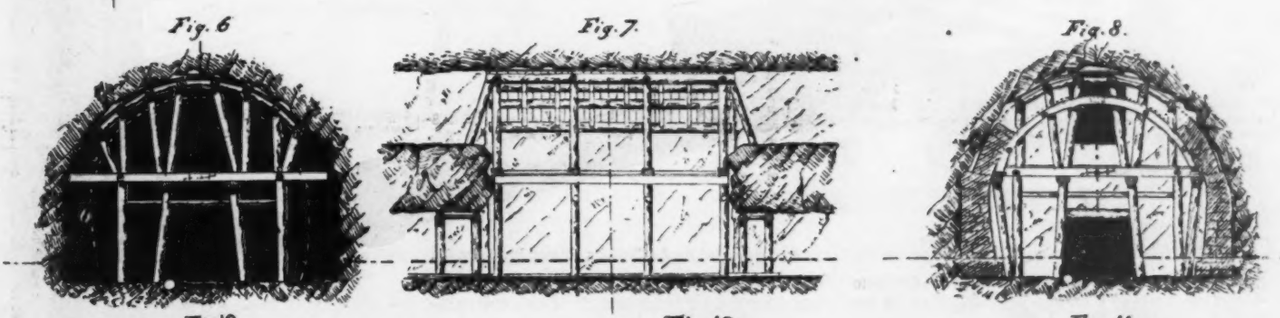


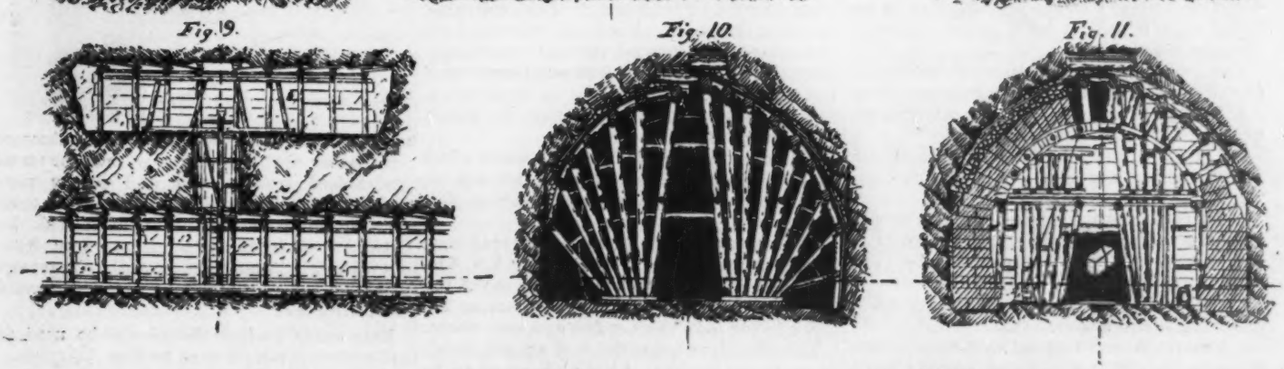
Fig. 1. Sketch showing the manner of working the Tunnel.

r indicates the Upraises.









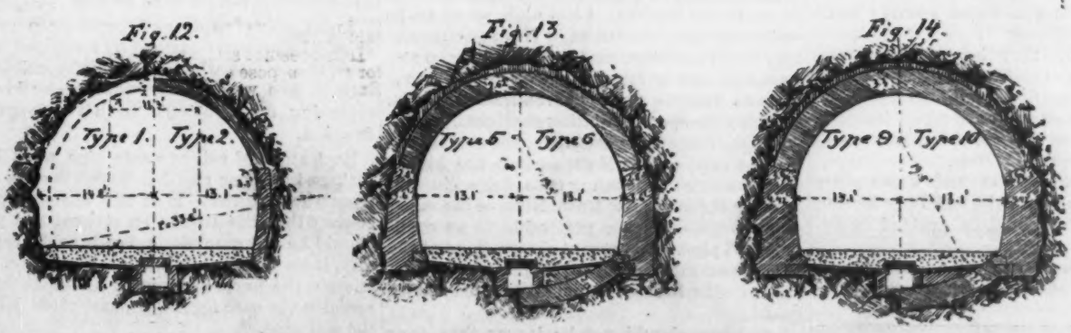


FIG. 2, 3, 9, 10 AND 11 REFER TO THE WEST-HEADER, FIG. 5, 6, 7 AND 8 TO THE EAST-HEADER.
THE HEAVIER TIMBERING IN THE FORMER SHOW THE DIFFERENT CHARACTER OF GROUND.

CROSS-SECTIONS, ETC., OF THE ARLBERG TUNNEL.

HOUSE DRAINAGE.*

BY WM. PAUL GERHARD, C. E.

In reply to many inquiries on the subject, the following brief description of the "Durham System of House Drainage" is submitted.

The *chief features* of this system are *proper mechanical construction*, and *use of materials of superior quality*. The system of drain, soil, waste and air pipes, and the methods of ventilation and trapping are essentially the same as those generally practiced in the best works of "sanitary drainage," and all important features agree with standard rules and regulations of Boards of Health.

A well-planned and well-constructed system of house drainage should remove completely and as speedily as possible all waste matters from dwellings by *pipes thoroughly and tightly jointed*. The danger of infection arising from defective drainage and plumbing may be reduced to a minimum by a *proper system of trapping and ventilation*.

The following are the *essential features* of any thorough system of house drainage, viz: †

1. EXTENSION OF ALL SOIL AND WASTE PIPES THROUGH AND ABOVE THE ROOF.
2. PROVIDING A FRESH-AIR INLET IN THE DRAIN AT THE FOOT OF THE SOIL AND WASTE PIPE SYSTEM.
3. TRAPPING THE MAIN DRAIN OUTSIDE OF THE FRESH-AIR INLET, IN ORDER ENTIRELY TO EXCLUDE THE SEWER OR CESSPOOL GASES FROM THE HOUSE.
4. PROVIDING EACH FIXTURE, AS NEAR AS POSSIBLE TO IT WITH A SUITABLE TRAP.
5. PROVIDING VENT PIPES TO SUCH TRAPS UNDER FIXTURES AS ARE LIABLE TO BE EMPTIED BY SIPHONAGE.

These are what may be called *general maxims* and they are embodied in the following detailed rules on house drainage:

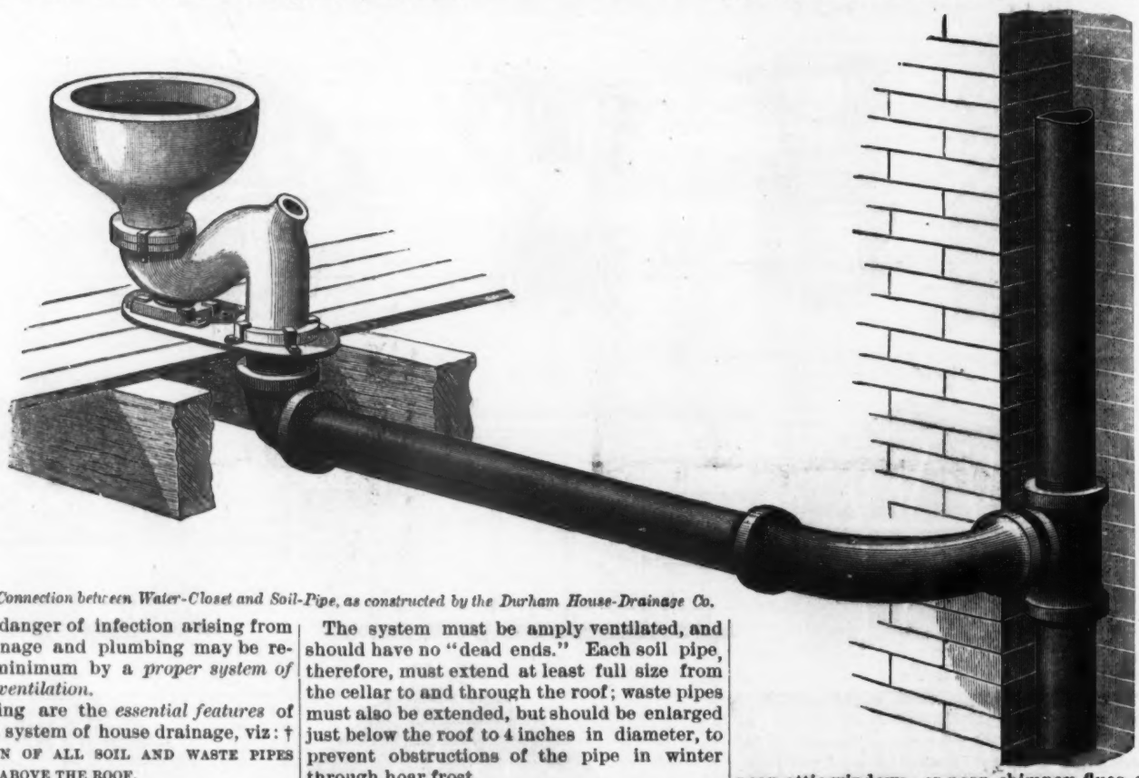
All drain, soil, waste and air pipes inside of a dwelling (except the short branch wastes from fixtures) should be of iron.

The arrangement of soil and waste pipes must be as direct as possible, and long branch wastes under floors should be avoided everywhere.

Each stack should run up as straight as possible, avoiding offsets, which are objectionable.

None of the waste or vent pipes should be buried out of sight and rendered absolutely inaccessible. It is preferable to keep them in sight, except on the parlor floor. The public has long been accustomed and does not object to the running of steam pipes in plain sight, and there is no reason why soil pipes should not be treated in the same manner. Their outside can be painted, or, if desired, it can be gilt or bronzed, as is done with steam pipes. Where pipes must be placed in recesses or chaces in the walls, or in partitions, they should be covered with wooden panels, or boards, fastened with screws, so as to be easily removed, should an inspection of the plumbing become necessary.

The soil,, waste and air pipe system should be thoroughly tight, not only water-tight, but air-tight as well. Hence, the pipes must be of thoroughly sound material, and all joints must be perfectly made.



Flexible Joint Connection between Water-Closet and Soil-Pipe, as constructed by the Durham House-Drainage Co.

The system must be amply ventilated, and should have no "dead ends." Each soil pipe, therefore, must extend at least full size from the cellar to and through the roof; waste pipes must also be extended, but should be enlarged just below the roof to 4 inches in diameter, to prevent obstructions of the pipe in winter through hoar frost.

Wherever practicable, soil and waste pipes should run along a heated flue, as this will assist in creating an upward draft in the ventilating pipes.

Soil, waste or vent pipe extensions may also, wherever convenient, run through a hot flue, terminating at least 2 feet above the top of the flue, but in no case shall vent pipes or air pipes be run only to a hot flue and stop there.

The extensions above the roof should, in all cases, be not less than 2 feet high, so as to be well exposed to air currents; if near a chimney top, they must terminate well below it. In any case, soil pipe mouths should be located as remote as possible from the ventilating shafts, chimney flues, or ventilating skylights.

The mouths of all pipes above the roof should be kept *wide open*. Return-bends are highly objectionable; ventilating caps clog up in winter time through hoar frost. None of the many patent ventilators are preferable to an open-mouthed pipe. To prevent obstructions of the pipe, insert into the top a copper mushroom-shaped wire basket (commonly called leader guard.)

Soil pipes should not be larger than four inches in diameter; vertical waste pipes for sinks or bowls, are generally 2 inches in diameter.

Each vertical line of air pipes must be at least 2 inches in diameter, increasing at the upper floors (in the case of high buildings) to 3 and even 4 inches diameter.

Each line of air pipe should extend as straight as possible up through the roof, where its mouth should be well exposed to the wind, and provided with a grating, screen or basket for protection. Air pipes may, however, branch into their soil pipe above the highest fixture, thus avoiding a large number of holes on the roof.

Each vertical line of air pipe must have the necessary fittings to connect the branch air pipes from traps to it. It is a mistake, frequently made, to use inferior material (lighter pipes) for such air pipe. They must, invariably, carry more or less foul gases, their joints should, therefore, be as tight as those of soil and waste pipes.

Leader pipes, if inside the walls, must be of cast iron or wrought iron, with thoroughly tight joints. If the leader opens at the top near attic windows, or near chimney flues or ventilating shafts, and if it is made of metal (galvanized iron or tin) and passes near windows of living or sleeping rooms, it must be trapped by a trap, with deep seal, located out of reach of the frost. Iron leaders with tight joints opening at the top remote from flues, or ventilators, or windows, should not be trapped.

Rain water leaders should not be used as soil pipes nor soil pipes as leaders.

Areas, court yards and paved open spaces should be properly drained by a trapped waste pipe, the trap of which should, if possible, be located inside the cellar wall accessible for cleansing, and protected from the danger of freezing.

Each stack of soil or waste pipe must have fittings in proper position to receive the flow from the fixtures. It is not absolutely necessary that the fittings on vertical soil pipes should be Y branches; a Tee-branch, especially, if its flow line is shaped in a curve, will answer the purpose as well, and such is especially the case for small waste pipes joining the soil pipe.

The flow from all soil and waste pipes is collected in the cellar, the aim always being to concentrate the system as much as possible. As a rule, it is better to connect the rain water leaders with the drain that carries the waste

* The following article explains the system and the practice of plumbing and draining houses as carried out by the Durham House Drainage Company.

† See "House Drainage and Sanitary Plumbing," by W. P. Gerhard, C. E. Published by D. Van Nostrand, 2d Ed., 1884.

See also, "Hints on the Sewerage and Drainage of Dwellings," by Wm. P. Gerhard. Published by W. T. Comstock, N. Y., 1884.

water of the household. In country residences where the rainfall is collected in a cistern, a separate system of pipes is required, and this is also the case, wherever the sewerage system of the city is the so-called "separate system."

The junction between upright soil, waste or leader pipes, and the horizontal drain, is of the greatest importance. The best support that could be given to it, is to build a brick pier under it, and to rest the weight of the upright pipe stack on it. Sometimes a strong wooden post is of service, though not making as substantial a job as a brick pier. The junction should be made with an elbow fitting of a large radius, or with Y-branches and 45° bends, in order to make the change in the direction of the flow as gradual as possible. A right angled connection must not be tolerated, as it is sure to cause accumulation of soil and create stoppages.

It is to be recommended to run the main cellar drain *in sight* along one of the foundation walls, or to carry it along the cellar ceiling suspended from the joists or iron beams by strong iron hangers.

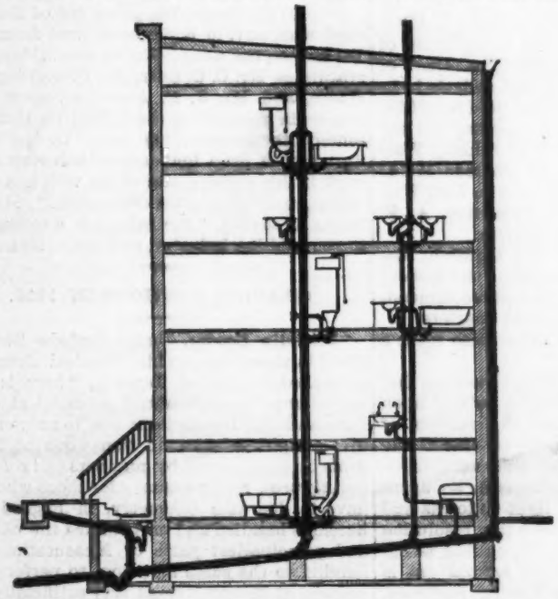


Fig. 1.

Where there are fixtures in the cellar, the main drain must run below the floor, and in this case it is advisable not to bury it entirely out of sight. Cleaning hand-holes should be provided at all junctions of branch drains with the main, also near or at bends, at the trap, and at the foot of vertical stacks. These hand-holes must be left accessible by building small man-holes provided around them with covers.

Many authorities require every drain below the cellar floor to be laid in a trench with concrete bottom and with bricked walls, accessible throughout its entire length. This seems necessary only where inferior material is used, and where the workmanship is not first-class. With heavy iron pipes tested not only at the foundry, but also after being placed under the floor of a house (by the water or air pressure test), and with few well-made joints it is better to bury the drain pipes in concrete, leaving out places for access only wherever really needed.

For all horizontal or inclined drains the rule should be laid down, that no junction should be made at right angles, with Tees; 45° Y or 67½° Y-branches must be used. All changes from the straight line must be made with curves of a large radius. It is advisable to use near junctions, curves and traps, hand-holes giving ready access to the drain pipes in case of accidental or malicious stoppage.

The fall required for the main drain will depend upon its size; the latter should not exceed six inches in most cases. Where a building is unusually large, it is better to have two main drains, each six inches diameter, than one drain of nine inches. As a rule, however, four and five inch drains are ample for ordinary sizes of dwellings. Such a drain should, if possible have a fall of ½ inch to the foot, but a fall of ¼ inch to the foot is sufficient to carry along whatever ought only to enter such pipes.

Wherever such fall cannot be had, it is advisable to arrange a flush tank at or near the head of the house sewer, to be operated by hand at frequent intervals or else to discharge automatically.

If the main drain is trapped, as is advisable in most cases, the running trap of iron should be located just inside the cellar wall or else outside the house, in a man-hole. It should be located where it is not exposed to freezing.

In any case the trap must not be absolutely inaccessible, as it is possible that obstructions may occur at this point. The trap should, therefore, be provided with cleaning holes, closed air-tight with well-fitting covers. It is advisable to run into this trap a leader, so as to insure its occasional flushing at each rainfall.

To insure a full circulation of *fresh air* through the pipes, a fresh air pipe, of the full diameter of the iron drain, must run from just inside the trap to some point outside, well remote from windows, so as not to cause any objectionable smell, as it becomes at times—though seldom—an *outlet* instead of an inlet.

As soon as the main soil and drain pipe system is completed, its tightness should be tested by the water pressure test or by the peppermint test.

Another equally reliable test is the air pressure test by a force pump and a manometer. In this test every part of the pipe system is subject to a *uniform* pressure, while in the water test the pressure increases with every foot of head of water, thereby often putting an unusually severe strain on the lower part of the pipe system.

The house drain should be of iron, to a point well beyond the foundation walls. Whether it should be continued any further with iron pipe or whether vitrified, well-glazed pipes may be used for the external sewerage, will depend entirely upon the character of the soil. For made ground, *heavy* iron pipe is decidedly to be preferred, but care must be taken to lay the pipes on a good solid foundation. It is also safer to run a drain of iron pipes, where it passes near a well, furnishing drinking water. Occasionally roots of trees cause considerable trouble with vitrified pipe, especially if the joints of the latter are poorly cemented. In such a case, iron pipes, with caulked joints, are preferable.

Figs. 1 and 2 represent sections through a city and a country dwelling, showing all drain, soil, waste and air pipes; also the fixtures and the mode of trapping these.

Fixtures should be concentrated as much as possible in vertical groups.

Fixtures should never be located in rooms without proper and ample ventilation.

It is preferable to locate water-closets and urinals in well-lighted apartments having windows to the outer air. This insures cleanliness and prevents fouling of fixtures through improper use.

Each fixture should, wherever possible, discharge into the main soil or waste pipe independently. The branch wastes should in all cases be as short and direct as possible, and this will largely depend on a judicious planning and locating of fixtures by the architect. Waste pipes of lead should be of the following sizes:

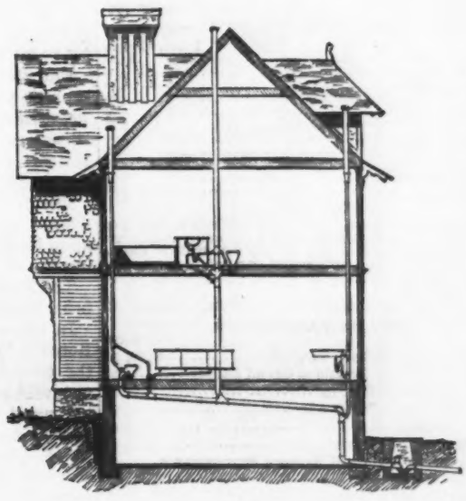


Fig. 2.*

For one wash-bowl	1¼	inches diameter,
For a row of basins	1½	" "
For a bath-tub	1½	" "
For a row of bath-tubs, likely to be used at once	2	" "
For a pantry sink	1¼	" "
For a kitchen sink	1½	" "
For a set of laundry trays	1½	" "
For a slop sink	1½–2	" "
For a urinal	1½	" "
For a row of urinals	1½–2	" "

The weight should be about 2 lbs. for 1¼ inch pipe, 2½ lbs. for 1½ inch pipe, and 3 lbs. for 2 inch pipe. All joints in lead pipe should be wiped solder joints, and no cup joints should be tolerated, except where local circumstances render the wiping of a joint impossible.

Where lead pipes join the wrought-iron pipe the following mode of connection is recommended: Lead waste pipes and lead branch air pipes from traps are connected by brass screw nipples, wiped to the lead pipe with solder, and screwed tightly with red lead and a wrench into the threaded opening of the fitting.

Each fixture connected to the soil or waste pipe system, must be provided as near as possible to its outlet, with a suitable trap, secure against siphonage, back pressure, evaporation, etc. If lead traps are used, the weight of the lead should be equivalent to the weight of the lead pipe.

TO BE CONTINUED.

*Fig. 2 is borrowed from Mr. Gerhard's book "Hints on the Drainage and Sewerage of Dwellings" just published by W. T. Comstock, 6 Astor Place New York.

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METRIC CONVERSION TABLES.

Our correspondent "F. B." comments upon our too brief disposal, a week ago, of a newly published metric conversion table. In explanation we must say that we spoke as laymen; our critic is an acknowledged expert and a leader in the movement for the universal adoption of the metric system. To him and his peers the tables mentioned, are no doubt as useful as he says they are, and we are glad to hear that they have value. *We* are still groping, in a manner, in the outer darkness of the old English "barley-corn inch," and, as a measure of stress, the expression "kilogrammes per square centimetre" does not yet convey to us quite as clear an idea of what is meant, as would "tons per square inch."

To our readers, more advanced than ourselves in metric measurements, we suggest the acceptance of "F. B's." criticism of the tables instead of our own.

But for the great majority of American mankind, those who have only an occasional use for such a work, the conversion table of the future is yet to be written. Captain Noble has extended it further than perhaps any other, but the peculiarity of the arrangement is such that the novice must generally calculate the thing for himself to be sure that he has taken his result from the right spot in the column; consequently, until the user is thoroughly initiated, the book is of little value as an economizer of labor. Lt. Rogers Birnie is more easily understood, and we think has issued the most useful of all metric conversion tables, but he has used a different fundamental value for the standard metre from that adopted by his predecessor; moreover his tables, as far as we know, are not published in a convenient form for common use.

The metric system has much merit, and its use is now common with many nations with whom we are brought into daily commercial and professional contact. A handy volume of conversion tables, one that cannot be misunderstood, even by the novice whose other engagements forbid his entering into the intricacies of the system, is to be desired.

The Engineer's Society of Western Penn'a

This Society held its annual meeting in Pittsburg on the evening of Jan. 15, at the rooms of the Western Iron Association. The report of the Treasurer shows that he had collected $1,925.89 for the year 1883, and had paid out $1,740

The following officers were elected for the present year: President, Wm. Miller; Vice-President, F. C. Phillips and Thomas Rodd; Directors, Max Livingston, John L. Awl, Wm. Metcalf and S. B. Fisher; Treasurer, A. E. Frost; Secretary, James H. Harlow.

The retiring President, Mr. Gottlieb, delivered an address, congratulating the Society upon its flourishing condition and recommending the acquisition of permanent quarters.

The President-elect, Mr. Miller, also made a brief inaugural address.

In the course of the business meeting Col. Roberts introduced a resolution calling upon the Society to inquire into the subject of natural gas "for the purpose of elucidating information concerning the fluid with reference to its economic advantages as an agent for the supply of heat and light in towns and cities," Mr. Roberts followed this resolution with a paper upon the subject; calling attention to the fact that while this natural gas is now being introduced for heating purposes, little is definitely known of the law of resistence or friction of gas in pipes, under different pressures; as to the best means of consuming it, or the danger from explosions. Two hundred companies are now organized for the introduction of natural gas, and their pipes are being laid in every direction; he thought the danger from explosion real and imminent.

Mr. Jarboe remarked that he had investigated the subject for years; had been blown up three or four times, and did not propose to give the natural gas companies the benefit of his experience by reading a paper, as requested.

Mr. Metcalf said he was in favor of natural gas or any gas than that now in use in Pittsburg for lighting purposes—none could be worse. The resolution of Col. Roberts was adopted.

THE ACHAFALAYA BRIDGE.

The Achafalaya Bridge, on the line of the Texas and Pacific R. R., 130 miles west of New Orleans, was opened, as previously announced by us, on December 26. This structure is 1045 ft. long and consists of two fixed spans of 253 ft. each, one of 163 ft., a draw-span of 303 ft., and 73 ft. of trestle approaches. The truss is an iron Pratt, double cancellation. The piers are made up of two iron cylinders each; 8 ft. in diameter, and made of cast-iron below the river bed, and wrought-iron, lap-jointed and rivited above the bottom. The foundations are in no case less than 120 ft. below high-water mark, and are from 70 to 115 ft. in the ground. The material passed through is blue clay and sand, the columns are now founded upon gravel. Much difficulty was experienced from sunken drift wood, and, in carrying on the work, from the sickly nature of the bridge site.

Actual work upon the foundations was commenced in September, 1881; but from the unprecedented high water of December, 1881, work was suspended until July, 1882. The original plan contemplated sinking the cylinders by the Plenum pneumatic process, but upon resuming work it was found that the river-bed had scoured out to such an alarming extent that 90 ft. below high-water, the estimated depth of foundations, was no longer safe. As the probable depth would now exceed the practical use of compressed air, the further sinking of the iron cylinders was accomplished by an excavating apparatus (described in ENGINEERING NEWS, May 5, 1883) designed by Mr. John F. Anderson, the superintendent and engineer-in-charge. By this machine one cylinder was successfully sunk through 115 ft. of ground.

Gen. G. M. Dodge, the president of the railroad company, in a despatch sent from New York, upon the completion of the bridge, congratulates Mr. C. C. Barr, the Consulting Engineer, and Mr. J. F. Anderson, upon their success in overcoming the difficulties that presented themselves; as Gen. Dodge says, "greater in deep foundation than any other work in this country, and which will, to a great extent, revolutionize the old system." He continues by saying, "the bridge is a monument to your ability, industry, and perseverance."

GRAPHIC METHODS IN 1650.

"Friendly Reader," says Captain Thomas Rudd in the preface to his Practical Geometry published in 1650 at London, "here is presented unto thee a hundred geometrical questions and also Instructions how to answer and give a right solution to every one of them, some by lines, some by numbers (*yet all without Algebra*), very necessary for those who will have to doe with Geometry, in Regard that herein is handled and propounded the chiefest and principallest parts of Measurations belonging to the same art; how to perform all manner of Measuringings very artificially and speedily; and how to finde out Lines which be hidden or secret in the same; to the great ease and pleasure of the Practiser and also very delightfull to all men." Captain Rudd's book deals largely with the surveying and laying out of land and is a quaint and interesting work showing how men thought about such subjects two hundred years ago. Surveying he said had its origin in Egypt, "for when Nilus with his inundation drowned and confounded the Limits of their Lands, certaine of the most ingenious Inhabitants were constrained to find out the rules of Geometry, by the benefit whereof (after the fall of the water) every man had his portion of ground restored to him again."

Rule for Guaging Casks.

Probably no more convenient rule for guaging casks can be stated than that of the prismoidal formula, so extensively used by railroad engineers for the measurement of earthwork. To find by this rule the contents of a cask it is only necessary to measure its length, the diameter at the end and the diameter at the bung. Then find the areas of the circles corresponding to these two diameters. Add the end area to double the bung area and multiply the sum by one-third the length. If all the dimensions are in inches this product will be the number of cubic inches in the cask, which divided by 231 will give the number of gallons. For example, suppose a cask 18 inches long, 12 inches in diameter at the end, and 16 in. diameter at the bung. It is easy to compute 113.10 for the end area and 201.06 for the bung area in square inches. Then the above rule gives the contents 3091.32 cubic inches which is equivalent to 13.39 gallons.

GAS vs. ELECTRICITY.

The City Councils of Dayton, O., have been investigating the relative cost of gas and electric light for street purposes. From a report made to them by City Engineer, Mr. Jos. E. Waltz, we make the following abstracts: The gas fixtures used in the comparison are the common 8 glass lantern, on a 400 lb. post; and on a 50 ft. street, cost for erection, $30.00, including the service pipe; the electric light is a Fuller, hung at the intersection of the centre lines of two streets, 2,000 candle power. Distance between gas-lamp-posts, 175 ft.; electric lights about 600 ft. apart.

By an actual experiment, four electric lights were found to take the place of twenty-three gas-lights. The electric lights cost $166.66 per year, each, or $666.64 for the four.

The cost of twenty-three gas-lights from the official time schedule is as follows:

Number of hours per post per year	3,674⅔
Number of feet per post per hour	4
Number of feet per post per year	14,697⅓
Cost of gas per 1,000 feet	$ 1.43
Cost of gas per post per year	21.01.7
Cost of lighting per post per year	4.50
Cost of gas light per post per year	25.52
Cost of gas light for twenty-three posts per year	586.96
Recapitulation:	
Electric light	$666.64
Gas light	586.96
Difference in favor of gas	$ 79.68

The Committee of Councils having the matter in charge have filed the report and invited petitions and remonstrances from the property owners who will be effected. Nothing is definitely stated referring to the relative qualities of light furnished.

THE SEWERAGE OF BOSTON.

In speaking of the completion of the Improved Sewerage System of Boston, in our issue of Jan. 5, we inadvertently gave credit for the *conception* of the scheme to Mr. Joseph P. Davis, late City Engineer of Boston, instead of to the Commission named, who in their report of 1875 actually outlined the system now in operation. But Mr. Davis should be credited with the elaboration of the many details required for the successful execution of the plan proposed, and for the present Dorchester Bay portion of the outlet sewer, recommended by him as preferable to that suggested by the Commission.

As of interest at this time, just after the successful inauguration of the most comprehensive and elaborate system for the disposal of sewage on our continent, we give a brief and general sketch of the work from its conception.

The subject of the drainage of Boston had been for some years referred to in no doubtful terms in every one of the reports of the Mass. State Board of Health, and in their fourth report they urged that an engineer be appointed to suggest a "comprehensive and harmonious" system of drainage and sewerage. In 1873 a City Board of Health for Boston was appointed, mainly to further this much needed improvement, and from its organization this body constantly urged the matter upon the city authorities.

In 1872 the State Legislature passed an Act authorizing the appointment of a Commission to investigate and report a thorough system of drainage for the metropolitan district; but as by the wording of the act, Boston was to pay all the bills, the Commission was not appointed, upon the ground that the expenses of the investigation should be shared by the other cities, as would be the benefits.

On Dec. 28, 1874, the City Board of Health, in a communication to the City Councils, clearly pointed out the evils of the existing system and strongly urged that a radical change should be made. And as a result of this action a Commission was appointed by Samuel C. Cobb, then Mayor of Boston, under the authority of orders from the City Councils, dated Feb. 26 and March 1, 1875. The Commission consisted of E. S. Chesbrough, C. E., Moses Lane, C. E., and Charles F. Folson, M. D., and they at once entered into the investigation of the problem presented, their first meeting being held upon April 23, 1875.

The report of this Commission is one of the most valuable existing documents upon the general disposal of sewage, and with the several reports of the Mass. State Board of Health, presents the subject in a more comprehensive and practical form than can probably be found elsewhere.

The evils of the system as found by them in Boston chiefly arose from the additions being constantly made to the area of that city by the filling-in of the marginal waters. The sewers were necessarily extended through these low districts, on very flat grades, and without a definite comprehensive plan. Bad material was used in filling, old sea-walls, docks, etc., were covered up, and as a consequence, the tide practically ebbed and flowed under many parts of the city; and as many of the sewer outlets were fitted with tide-gates, it happened that at high tide the flow of sewage was stopped entirely, the heavier portions deposited in the sewers, and the surrounding ground was saturated to a most troublesome and dangerous degree.

In seeking a remedy the Commission adopted the following as a guiding formula. "The sewage should start from the houses, and go in a continuous current without stopping until it reaches its destination, either in deep water or on land."

To the commission there were but two remedies possible; the first included the raising of more than one half of the superficial area of the city at an enormous and wasteful outlay of money; the second, the plan adopted, consisted of intercepting sewers and pumpage.

In relation to the final disposal of the sewage, which had first to be considered, they decided that precipitation only *clarified* the sewage without *purifying* it, and that neither pecipitation nor irrigation were remunerative. They recommended the carriage of the sewage to some point in deep water, remote from dwellings, and beyond the possibility of doing harm; with a provision for utilizing the more valuable portions, if by any advance in agricultural chemistry, such utilization should become profitable.

To ascertain the best situation for the outlet of the main intercepting sewer, extensive experiments were made with floats in different parts of Boston Harbor, and the north end of Moon Island was selected as the most suitable point of discharge, under the circumstances.

The general plan recommended by the Commission was a system of intercepting sewers, practically following the water front of the city, into which all existing sewers should discharge; the main intercepting sewer was to be located near Savin Hill, crossing the Neponset River by syphon, and thence along the Squantum beach, across Squantum Point to Moon Island. The syphon under the Neponset River was to be of wrought iron, 6 ft. in diameter and 1,500 ft. long; there was to be a 25,000,000 gal. reservoir on Moon Island, arranged to discharge its contents into the sea at each tide two or three hours after high water (a map showing the plan proposed and the report of the Commission in full was published in ENGINEERING NEWS for 1876). This system necessitated pumpage of the entire drainage of Boston, and the pumping works as located by the Commission, were to be just north of Savin Hill, near the Neponset River; three engines of 145 horse-power each were proposed, the lift to be from 20 to 33 ft. The size of the out-fall sewer proposed was of a capacity sufficient to carry the sewage of one million inhabitants, and also one-fourth of one inch rain-fall per day from an area of thirty square miles. Its capacity was 4,145 cubic feet per second. In determining the size of the sewers, 75 gallons per day per inhabitant were assumed, but as the *maximum* flow would be at the same rate as if this were all to be discharged in *twelve* hours, the sizes fixed were large enough to discharge double that amount. The total estimated cost was $3,746,500. The report included recommendations for an extension of the system to the neighboring cities of Cambridge, Charlestown, Chelsea, etc.

The report of the Commission, as outlined above was submitted to a joint special committee of the City Councils; this committee reported June 12, 1876 and recommended the adoption of the report, and an appropriation to cover the expenses of the preliminary surveys. The appropriation was made and the necessary surveys at once commenced under Mr. Davis.

Legislative authority being required to authorize the construction of the system, an act was passed in 1876 empowering the City of Boston to construct the necessary works; and the City Treasurer was authorized by Councils to borrow $3,712,000 for the purpose, and the Joint Special Committee on Improved Sewerage were given power, by the same body to contract for an improved system of sewerage, "substantially in accordance with plans made by Joseph P. Davis, City Engineer," with the pumping station located at Old Harbor Point and its outlet at Moon Island.

Mr. Davis, the City Engineer in his report to the Joint Special Committee, of July 9, 1877, gives the results of his more elaborate investigation of the subject, and the reasons for changes proposed and adopted by the committee. In all the schemes presented in this report it is assumed that at some future day a *high-level* intercepting system will be added; they are all alike in their main features, and correspond with that proposed and recommended by the Commission of 1875 After the passage of the order of the City Councils, other points of outlet were suggested than those named in the order, and all these were thoroughly investigated by Mr. Davis, with the result that Moon Island was again recommended as the most suitable. As being found cheaper and more advantageous than the Neponset river plan suggested by the Commission, Mr. Davis recommended the location of the pumping station on Old Harbor Point and the crossing of Dorchester Bay by a tunnel as now built. The arrangement of the pumping station, the flushing tanks, pumping engines, and in fact all the detail of the entire system of intercepting sewers and the final disposal of the sewage was the work of Joseph P. Davis and his engineering staff. What these details mean in all their elaboration and completeness we have endeavord to explain from time to time to the readers of ENGINEERING NEWS. The successful operation of the works and the fact that even a greater velocity of flow is obtained than estimated originally, prove the soundness of the theories upon which this detail was based, and the care with which the works were constructed by Mr. Davis and his successor.

THE distances, often many miles, through which gas is transmitted before it issues are such that with any other mode of distributing power, they would, says the *Engineer*, considerably enhance the cost of the power. Prof. Osborn Reynolds thus explains this: It takes about 10 cubic feet of gas to develop 1,000,000 foot pounds in a gas engine, whereas of compressed air in the ordinary way it would require something like 140 cubic feet to yield the same power. Hence the comparative cost of transmitting 40 cubic feet of compressed air, and this would be about as 1 to 25; so as a means of distributing energy gas is 25 times more efficient than compressed air.

HON. PLINY HOAGLAND of Fort Wayne, Ind., a wealthy miller and railway builder, died suddenly on Friday, aged 75.

Report of the Coast and Geodetic Survey for 1882.

The series of scientific papers appended to the annual report of the U. S. Coast and Geodetic Survey during the past thirty years is one of very great value, and the volume for 1882, which has just been issued from the government printing office, fully sustains the high character of its predecessors. Its appendix contains sixteen articles on astronomical, geodetical, meteorological and hydrographical subjects which must prove of interest and value to surveyors and scientists generally, as well as to those engaged in the actual investigation of such matters. Of these articles we will give the titles and make brief remarks concerning them.

The description and construction of a new compensation base apparatus, by C. A. Shott, is the first article. The apparatus is five meters in length, made with zinc and steel bars, and is simple in construction and easier of use than the older forms.

A report on the measurement of the Yolo base in California, by George Davidson, describes how the new base apparatus was applied and used. The length of this base line is 17,490 meters and the actual time employed in making two measurements of it was 38 days.

The field work of the triangulation, by Richard D. Cutts, is a reprint, with the additions of the manual used by triangulation parties. Before the publication of this article Gen. Cutts died, aged 77 years. He had been connected with the Coast Survey during the greater part of his life and had attained the high position of the first assistant in the service.

The construction of observing tripods and scaffolds, by C. O. Boutelle, gives plans and estimates for such constructions of various heights up to 102 feet.

The secular variations of the magnetic declination in the United States and at some foreign stations, by Charles A. Shott, is the fifth paper on this subject, the first having appeared in the report for 1859. It discusses the observations at 82 stations with about 837 results. Formulas are deduced for the magnetic declination at 64 stations, and tables given showing the computing values for every ten years.

The distribution of this magnetic declination in the United States at the epoch January 1885, with three isogonic charts, by Charles A. Shott. This without doubt is the most complete discussion of the magnetic declination in the United States ever published and indicates a great amount of labor on the part of its author. First are given tables of the observed declination at 2,359 stations. By means of the investigation of the preceeding article these are then reduced to the time Jan. 1, 1885. Lastly these results are plotted on a chart and the lines of equal magnetic declination drawn. One chart is given for the eastern half of the United States, another for the western, and a third for Alaska. The curves of equal declination are drawn for every degree, and indicate many interesting magnetic irregularites which were previously unsuspected. These charts will prove of the greatest value to land surveyors.

Records and results of magnetic observations made at the charge of the Bache fund of the National Academy of Science, from 1871 to 1876. These observations were placed by the Academy under the charge of Prof. Hilgard and the results are thus given in detail.

Comparison of the survey of the Delaware river of 1819, between Petty and Tinicum islands, with more recent surveys, by Henry L. Marindin, is an interesting contribution illustrated with sections showing the shoaling and deepening.

A study of the effect of river bends in the lower Mississippi, by Henry Mitchel, gives several inductions regarding the relation between the radius of the bend and its cross section of the river.

Discussion of the tides of the Pacific coast of the United States, by William Ferrel, is a paper furnishing results for the purpose of predicting the tides.

A report on the Siemens electrical deep-sea thermometer, by J. R. Bartlett, gives a description of the method of using the instrument.

Deep sea soundings off the Atlantic coast of the United States, by J. E. Pillsbury, relates to the operations of the steamer Blake during 1880–1883. The deepest sounding made was 4,651 fathoms.

The total solar eclipse of Jan. 11, 1880 observed at Mount Santa Lucia, California, by George Davidson, gives results obtained at an elevation of 5,700 feet.

An article on stars near the South Pole, by C. R. Powalky, is quite lengthy and is said to be very valuable.

The report of a conference on gravity determinations, relative to the most advantageous mode of presenting pendulum observations, containing matter interesting to geodetic surveyors.

Results of the trans-continental line of geodetic spirit-leveling from Sandy Hook, N. J. to St. Louis, Mo., by Charles A. Schott. This gives in detail the observations of the line, which it is proposed to continue across to the Pacific. The line runs near the thirty-ninth parallel passing through Reading, Pa., Hagerstown, Md., Cincinnati, O., Vincennes, Ind., and Salem, Ill. It is marked at frequent intervals by permanent bench marks.

Besides the above sixteen papers, the report contains the usual information concerning the work accomplished during the fiscal year ending June 30, 1882, and the usual maps showing the progress of the triangulation up to that date. It also has an appropriate memorial of Carlile P. Patterson, who died during that year while Superintendent of the Survey, after a lifetime spent in its service.

Review of the Industrial Interests of 1883.

During 1883, 38,823 traders were reported to Bradstreet's Commercial Agency, out of which, 10,299 failed. Their nominal assets were $140,498,714 and their actual assets $90,804,728. General liabilities, $175,968,085. In the New England States there were 1,507 failures out of 92,140 traders. In the Middle States, 2,328 failures, among 242,303 traders. In the Southern States, 1,982 failures, among 136,912 traders. In the Pacific States, 901 failures, among 27,087 traders. In the Territories, 299 failures, among 16,737 traders. In New York there were 478 failures, among 39,031 traders. In Philadelphia, 284 failures out of 32,084 traders. In Boston, 230 failures, among 11,564 traders. The ratio of failures in the United States for the past five years, is indicated by the following figures: from 1879 to 1883, 49, 48, 47, 51 and 52. That is to say, the percentage is slowly increasing. The numbers of failures for these years were as follows: 6,652, 5,929, 4,350, 7,635, for 1882, and 10,299 for 1883. Liabilities in 1879, $99,636,000; in 1880, $57,120,000; 1881, $76,194,000; in 1882, $93,238,000; last year, $175,968,000. This rapid increase was due to a number of causes, chief of which were, the fact that the producing capacity of the country grew more rapidly than the requirements; hence there was a great deal of surplus capacity and in the struggle for existence, prices were depressed, profits edruced and competition intensified, and failures resulted. The industrial interests have come to expect a panic every decade. The last one was unexpected, and shook the country from ocean to ocean. Manufacturers and consumers were crowded with stocks. To-day the conditions are different. The lesson learned then has been applied. Manufacturers and consumers have been guarding against the dangers of over production; have been reducing expenses, avoiding unnecessary outlay, watching the markets closely, and guaging production as much as possible, with the market and its requirements. Good results have already flowed from this course. The markets, instead of being overstocked, are only very meagrely supplied. Notwithstanding the fact that the increase in capacity for the past five years has been enormous, the condition of trade is excellent, and the outlook favorable. During the past year manufacturers, railroad builders, ship builders, and the representatives of all the great activities have been reducing expenses, and guarding production—wages have been reduced from ten to fifteen per cent. Indebtedness, has been for the most part liquidated. Values have been reduced to normal limits, mortgages have been wiped out. The contraction of bad debts has been restricted; banks have been reducing their usual liberal loans; single name paper is now difficult to negotiate, and in fact, in every direction there has been a drawing in of lines, and an effort to plant the industries upon a safe foundation. While there is an over-production in progress it is under control; while there is greater capacity than is required, the surplus is not a dangerous factor in the commercial problem. The working classes have wisely accepted the reduction in wages, and, should necessity call for it, would accept a still further reduction. It is probable that we shall continue to hear of failures, and that '84 will be as prolific in this line, as was last year. But the failures will be by way of prevention, and will only so much sooner clear the atmosphere, and enable those who have the strength to stand, more clearly to see the future, and provide for it. There are hosts of encouraging indications on every hand. Our manufacturing establishments are perfecting their appliances, and increasing their motive power. New England factories are increasing the number of their looms, putting in better engines, duplicating horse power, perfecting facilities in a variety of minor details, all of which facts indicate abundant confidence in the industrial future.

Throughout the Middle States there are numerous evidences of activity. Never before was there so much mileage under construction in Pennsylvania; in no two months in our history have so many contracts for rails been given out, as during the past 60 days. Our ship yards are crowded with orders for vessels, large and small, from Maine to the Delaware. The same is more or less true of the boat yards along the lakes and the smaller boat yards along the rivers.

The demands for transportation are growing: ship yards, boat yards, locomotive works, car shops, boiler works, bridge works and foundries, all show it, and each week adds to the favorable indications. Congress is blamed with having designs upon the interest of the people; the banks are blamed with designs upon the monetary system; but all these grumblings need occasion very little apprehension. Congress can do the vital interests of the country very little, if any, harm. A Presidential year is before us and only urgent legislation will be attempted. We need a better financial system, one adapted to the expanding requirements of the country, just as we needed a greater railway system to provide for the expanding energies of the people for the past five years. We need a merchant marine and will have it in due time, despite the lack of unanimity among those who are attempting to bring about a revival of American shipping.

M. W. BULLOCK has the contract from government to resurvey several sections in Gratiot Co. Mich.

NEW PUBLICATIONS.

SURVEYORS' AND ENGINEERS' FIELD BOOK AND CALCULATION RECORD: Consisting of Blank Maps of Sections, divided into Quarters by red lines, and sub-divided by faint lines, for convenience in locating Surveys; with blank for recording Witness Trees or other Bearings to Corners. The pages used for calculation may be used by the Engineer for noting Levels, Comprising Traverse Table, Natural Sines and Tangents, with other valuable Tables for the Engineer, etc. By J. B. Strawn, C. E. Price, $1.00.

Mr. Strawn, in his title, leaves little room for a further description of the book. We can only add that it is convenient in size, well printed on fine paper, is provided with a flexible leather cover; and with its sub-divisions and headed columns, it is just the handy volume required by the surveyor, for whom it is especially intended. The table of sines and tangents are given for every ten minutes, and the Traverse tables are sufficiently full for ordinary field work.

"A MANUAL OF USEFUL INFORMATION AND TABLES APPERTAINING TO THE USE OF WROUGHT IRON," published by the Passaic Rolling Mill Co., Patterson, N. J., Price $1.50.

This is a new work throughout, and is intended to supply such special information and tables as would prove useful to workers in wrought iron generally. The tables, with a few exceptions have been computed expressly for this edition, and are original in matter and form.

The contents include sections of "shapes," from I beams to picture cornice; fire-proof floor constructions and combinations of hollow brick and iron. The chapters devoted to strength, section and working loads of beams, girders, roof and bridge trusses, etc., will be found useful in estimating; and the numerous tables given will recommend themselves to every one valuing time.

PERSONAL.

The CHAPMAN VALVE Manufacturing Co. have removed their Boston office to the Mason building, No. 72 Kilby and 112 Milk Sts.

GEORGE P. ATWELL, a well-known contractor in Manchester, N. H., died on Monday, the 14th inst., at 37.

Secretary BOGART of the American Society of Civil Engineers was confined to his room by illness for several days of this week.

Mr. WILLIAM METCALF of the well known firm of steel manufacturers, Miller, Metcalf & Parkin of Pittsburg, was at the room of the American Society of Civil Engineers on Wednesday evening.

GENERAL MANAGER LAYING of the N. Y., West Shore & Buffalo Railway, has discharged the whole corps of civil engineers on the line and has taken the maintainance of way under his own charge.

Fire-Marshal SWENIE, City-Electrician BARRETT, and Commissioner CREGIER, of Chicago are visiting Pittsburg, Philadelphia, Washington, New York, and Boston for the purpose of examining all of the underground telegraph and fire-alarm systems, with a view of establishing a similar system in Chicago.

JAMES FREEMAN CLARKE, of Cleveland, O., died on Jan. 21, aged 78. He was a director of the Cleveland and Pittsburg R. R., from 1856 until his death; he was also at one time President of the Atlantic and Great Western Railway Co., and was Vice-President of that company at the time of his death. Mr. Clarke was also heavily interested in coal-mining and was President of the Ohio and Penn. Coal Co.

ROBERT HARRIS, Vice President of the N. Y. Lake Erie & Western R. R. Co., has been elected to succeed Mr. Henry Villard as President of the Northern Pacific Railway Co. Mr. Harris was for a long time connected with the Chicago, Burlington and Quincy R. R., and for the last four years has been Vice President of the Erie; he was also for a time President of the Manhattan Railway Co.; he has been a director of the Northern Pacific since Oct., 1879. It is understood that Mr. H. will resign his present position on the Erie R. R.

PROF. EDWARD FONTAINE died at his residence in Hinds Co., Miss., on Jan. 19. He was a Virginian by birth and a descendant of Patrick Henry; graduated from West Point, and afterwards became a Civil Engineer. He was Secretary of the Republic of Texas when Lamar was President, and for some years had charge of important engineering works in Texas and elsewhere; but for the last ten years has been a clergyman of the Episcopal Church. Prof. Fontaine wrote a number of works of a scientific character.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.: M. INST. C. E.

(Continued from page 34)

DLXXXVII.—FREDERICTON, N. B.

Fredericton, New Brunswick in lat. 46° 3', N. long. 66° 45' W., is on level ground on the right bank of the River St. John, 84 miles from its mouth, at the head of navigation by large steamers.

It was settled about 1780. Water-works were built by the city in 1883, after plans of Crafts and Forbes, C. E., taking the supply from the River St. John. A crib well is constructed about 600 feet from high water mark in the river, and the water admitted to it through broken stone, and then conveyed through 600 feet of 16-inch cast-iron pipe to a pump well, whence it is pumped directly into the mains by a steam pumping engine of one and one-half million gallons daily capacity, built by the Holly Manufacturing Co. Distribution is by 9 miles of cast-iron pipe, manufactured in Scotland, of 12 to 3 inches diameter, with 92 fire hydrants and 86 gates.

The population, in 1882, was 6,218. The works cost $85,000. No further information has been received.

DLXXXVIII.—ORANGE, N. J.

Orange, New Jersey is on rolling ground from 150 to 300 feet above tide level, 13 miles east of New York City. There is some manufacturing, principally of hats, but the city is chiefly occupied by residences of persons doing business in New York. It was incorporated a city in 1875. Water-works were built by the city in 1883, after plans of William B. Rider, C. E., taking the supply from the west branch of the Rahway River, which drains five square miles. An earthen dam 875 ft. long and 40 ft. high, with stone heart wall, forms an impounding reservoir covering 60 acres, and holding 250,000,000 gallons, at 350 ft. above the centre of the city, to which water is conveyed by five miles of 16-inch pipe. The water is passed through a filter, of sponge and charcoal, in the gate house at the dam.

Distribution is by 21 miles of cast-iron pipe of from 16 to 4 inches diameter, with 200 fire hydrants, 108 gates, and 150 taps. The works went into operation in October, 1883, and have cost $400,000, which is the amount of the bonded debt at 5 per cent. interest.

The population, in 1880, was 13,207. The works are managed by a committee of nine members of the City Council. Charles E. Metcalf is chairman.

DLXXXIX.—LYONS, MICH.

Lyons, Mich., in lat. 43°, N. long. 85° W., is at the head of navigation on Maple River. Water-works were built for fire protection only, by the village, in 1879; taking water from the river and pumping directly into the mains by a Holly rotary pump driven by water-power. The main is 1400 ft. long, of Wyckoff wooden pipe. The pressure is maintained at 100 lbs. in case of fire. A. H. Jacob is president of the village. The population, in 1880, was 747.

SELECTED MISCELLANY.

A FRENCH authority says that boots and shoes may be rendered permanently water-proof by soaking them for several hours in thick s ap-water. A fatty acid is formed in the leather by the soap, which makes it impervious to water.

THE original capitol building at Washington completed in 1827, cost (including grading of grounds, etc.,) $2,433,844.13. Since then the extensions, including cast-iron dome, made of 8,100,200 pounds of iron, repairs, and the rest, increased the original cost to a little over thirteen millions of dollars.

STATISTICS show that every seventh year has been a dry year in California for a long period. The last dry year was 1876, when only 9 inches of water fell in the rainy season. This year the quantity is very small, and unless all precedent is overturned, this will be a dry year, in which case there will be short crops of grain.

THE County Commissioners of Fort Wayne, Ind., have returned to the old system of time, and on Sunday the Court-house clock was set back 28 minutes. All the city and school clocks in Fort Wayne were also set back the following day.

ENGINEERING in China has achieved a notable triumph in the construction of the Bridge at Lagang, over an arm of the Chinese Sea. It is five miles long, built entirely of stone, has 300 arches seventy feet high, and the roadway is seventy feet wide. The pillars are seventy-five feet apart.

THE camels that were employed in hauling freight across the dry wastes of Arizona for the Southern Pacific Railroad, now by natural increase 400 in number, have been bought by John Shirley, an Australian sheep farmer, and are to be used in hauling freight across the deserts in Australia. He got them for $10,000, much less than a like number of camels would cost him if he were to transport them from Africa.

THE ship canal between the Baltic Sea and the German Ocean will, it is estimated, save a journey of 600 miles for a vessel making a trip between either of those waters, as the circumnavigation of the peninsula of Jutland will be unnecessary. In all, the proposed canal will be only some fifty miles—or about half that of the Suez Canal—extending from Gluckstadt to Kiel.

THE longest line of fence in the world will be the wire fence extending from the Indian Territory west across the Texas Pan Handle and 35 miles into New Mexico. It is said that 85 miles of this fence is already under contract. Its course will be in the line of the Canadian River, and its purpose is to stop the drift of the northern cattle. The fence will be over 200 miles long.

THE first great irrigation work in South Africa is now in course of construction at Van Wyk's Viel. The Parliament granted £20,000 for the work. The water dammed in, will cover an area of nineteen square miles, with an average depth of ten feet, and for two miles and a half the depth will be twenty-seven feet. This lake will be as large as Loch Katrine, Scotland, and will, when at the depths given, be a sheet of water equal to 350,000,000,000 gallons, and capable of irrigating for many months, thousands of acres. One rainfall, such as was experienced in April, would have kept the dam going for the purpose for which it was constructed for a whole year.

THE electric light seems to be settling down to steady business. Milan is lighting its tram-cars with it, and there is a talk of its employment on some of the tramway lines in London. Nearly all the great English railways are going to use it in their carriages. Mr. Alfred de Rothschild lights his brougham with it. Mr. Swan, of Swan & Edgar, uses it all over his residence at Bromley; and several private residences in the West End of London are illuminated from cellar to garrett by movable lamps, which are placed among flowers, in épergnes, on the table, and even attached to the heads of some of the beds for those who desire to burn the midnight carbon.

THE conversion of Electricity into light is now a fact of every-day utility, but the reverse process has been very slow of accomplishment. It has, however, been effected by Herr Sauer, whose sunlight battery has been described in the *Electrotechnische Zeitschrift*. The chemical rays furnish the power, and the battery will only act in sunlight. It consists of a glass vessel, containing a solution of fifteen parts of table salt and seven parts of sulphate of copper in 105 parts of water. In this is placed a porous cell containing mercury. One electrode is made of platinum, and the other of sulphide of silver, and both are connected with a galvanometer. When not in use the whole is enclosed in a box. When in use, the platinum electrode is immersed in the mercury, and the other in the salt solution; the battery is placed in the sunlight, and the galvanometer needle is then found to be deflected, the sulphide of silver being the negative pole. If the sun is clouded, or any other change in the intensity of the light occurs, it is indicated by the needle. The exact effect produced by the light rays does not, as yet, appear very clear, but their presence distinctly produces electrial action, and their absence suspends it.

CORRESPONDENCE.

THE "TOPOGRAPHER."

Special Correspondence Engineering News.

HOMEWORTH, COL. CO., OHIO, Jan. 19, 1884.

EDITOR ENGINEERING NEWS.—Does the writer of "The Topographer" really mean to convey the impression in Sec. 142, Page 106, that to an observer on the earth, "Polaris has an apparent motion east or west at the rate of fifteen degrees (15°) of Arc in one hour?" "and that in an observation for the meridian made at its upper or lower transit an error of four seconds (4") in time would create an error of one minute (1') in Arc?" This might be true if the declination of Polaris was zero (0°) or its polar distance 90°, but it seems to me that with the greatest possible error that could be made in time, five hours and fifty-nine minutes (5 h. 59 m.) would only make an error of about 1° 45' in lat. 41° N. in Azimuth east or west.

In his explanation of Fig. 34 on Page 107 he says: "The time of the greatest elongation can be determined with sufficient accuracy by observing when a line joining Polaris and Alioth is nearly horizontal (I suppose "nearly" is intended to cover the difference in time of the right ascension of the two stars) with this allowance, or if the two stars have the same right ascension, but different declinations, would the stars have the same altitude at the time of their greatest elongations, to an observer in any latitude, or at any place except on the equator, where his horizon would be in the same plane as the poles or axis of the earth! Unless they had equal altitude would a line joining them be horizontal?

G. R. G.

Emont's Metric Tables.

Special Correspondence Engineering News.

BOSTON, MASS., Jan. 14, 1884.

EDITOR ENGINEERING NEWS:—May I offer some comments of different tenor from the brief criticism you printed in ENGINEERING NEWS of the 21st inst., upon the recently published tables of Mr. Emonts?

The simplicity of their arrangement is one of their chief merits. The equivalents of lengths are grouped upon one page; those of area upon another page; of volume upon another; weight upon another; while upon the last page are gathered the compound and miscellaneous relations, density, pressure, work, heat, etc. Moreover, upon each page attention is paid to the position in which the items are placed. For example, the equivalents of inches, of feet, and of yards, occupy three columns at the head of the page devoted to length. The equivalents of square inches, of square feet, and of square yards will occupy three columns at the head of the page devoted to area; of cubic inches, cubic feet, and cubic yards, three columns at head of volume; a perfectly symmetrical arrangement. Among the weights, two, kinds of ounces are paired of in one column, two different kinds of pounds in another column, two different kinds of tons in another. On the compound page three spaces side by side are occupied by the correspondence of pounds per foot, and kilos per metre, the correspondence of pounds per square foot, and kilos per square metre, and the correspondence of pounds per cubic foot, and kilos per cubic metre.

The number of decimal places given in the equivalents, is enough for all ordinary business purposes, but figures are not strung out far beyond the possibilities of accurate measurement by any but extraordinarily delicate appliances. If the closest approximations known to science should be required, the means of obtaining them are afforded by the two fundamental equivalents given on the title page at full length, according to the most authentic demonstrations, and by the explanations in parenthesis of the less familiar unit-values, such as 277.274 cu. inches in British gallon and 2150.42 cu. inches in American bushel.

For the most important units, Mr. Emonts gives values for the nine digits of metric into old denominations, and for nine digits of old into metric denominations, in which respect he acts similarly to Prof. Rankine in his Rules and Tables; Lieut. Rogers Birnie in Ordnance Notes, and other authors. With that number of multiples prepared, it is an easy matter to compute any required equivalent. Mr. Emonts saves space by not giving so many values for some weights and measures less commonly used. Although a person who has to translate a great number of expressions might want, in the special kind of measure concerned, tables extended to a hundred or more entries, yet the limited extent of Mr. Emonts' tables makes them short and very handy for general tables adapted to the wants of the average man.

In the variety of denominations embraced, and especially in including units peculiar to the U. S. A., Mr. Emonts' tables are superior to others.

They have the additional advantage of being based on Clarke's determination in 1866, of the relation between the metre and the yard, which is accepted on both sides of the Atlantic as the best yet made. Lieut. Birnie's tables are based on the same; but others are generally based on Kater's determination, nearly sixty years ago. The difference is very small but is perceptible in the final decimals. For example, take the equivalent of 9 cubic inches given by Mr. Emonts as 147.480 cu. centimetres. Lieut. Birnie prints more decimal places and gives 147.47986983. Prof. Thurston's Conversion Tables contain Birnie's and with them, a few pages further on, the tables of Capt. Noble of the British Army, according to which latter the equivalent of 9 cu. inches is only 146.476 cu. centimetres. F. B.

WATER PRESSURE GAUGE.

Special Correspondence Engineering News.

AUGUSTA, GA., January 14, 1884.

EDITOR ENGINEERING NEWS:—Finding it impossible to find a steam gauge that will register properly the water pressure in this office, I ask you to give me the address of a few firms who manufacture *reliable* water pressure gauges. I also have a mercury gauge manufactured by the Novelty Iron Works of New York, Paul Stillman's patent. It appears to be a pretty good gauge but I cannot keep the mercury at the proper height in the tube. When the pressure is taken off it stands at 2½ lbs., when it should stand at zero. This is the second time it has gotten out of order in this way. I had it recharged the first time, but we are not certain it was done right. Can you give me the address of the Novelty Works, as I desire to correspond with them.

In times of a heavy freeze, like last week, it is important that I should be able to read the pressure to even a half pound.

I want a neat, handsome, and *reliable* gauge to put in my house, so that in cases of fire alarms I can know the condition of the water in the mains, at night, as I live some distance from the office. Can you give me a reliable way to test a hydraulic gauge? I have now a steam and mercury gauge on the same pipe in this office. The mercury gauge registers 19½ lbs. and the steam gauge 13 lbs. Both are wrong and I don't know how to test them. Please answer, as I am anxious to have the thing right. A. H. DAVIDSON,

Engineer and Supt.

ASHCROFT STEAM GAUGE WORKS,
111 LIBERTY ST., NEW YORK, Jan. 18, 1884.

MR. A. H. DAVIDSON,
Eng. and Supt. Augusta, (Ga.) Water-Works.

DEAR SIR:—Your letter of the 14th, addressed to the editor of ENGINEERING NEWS, is kindly handed us for reply, and in answer would say that we make about every class of instruments known for measuring pressures of steam, air, gas and water. We make a specialty of a water pressure gauge showing feet in column and pressure. We note what you say in regard to the mercury gauge made by the Novelty Iron Works—Paul Stillman's patent. That gauge has not been made, to our knowledge, for ten years past; the concern having gone out of business.

You ask for a reliable means of testing hydraulic gauge. If you will state the maximum amount of pressure you want to test, we can give you all the information necessary to enable you to make a test. As for the difference in the registering of the mercury gauge and steam gauge in your office, would say that it is quite important that they should both be piped exactly alike; the length of the pipes the same leading from the supply of pressure, and their height from the main supply the same, as all these conditions enter very largely into the question of their corresponding indications. If you will make a rough sketch showing just how your gauges are attached, the size of the pipe, and all the conditions, we will write you in full about it. We have made water pressure gauges so delicate as to indicate the *inches* of water in height on a dam, and the gauge located one thousand feet from the dam. We remain,

Very truly yours,
C. A. MOORE,
Vice-President.

THE MEMPHIS SEWERAGE.

Special Correspondence Engineering News.

PHILADELPHIA, Jan. 21, 1884.

EDITOR ENGINEERING NEWS.—A correspondent in your issue of Dec. 22d inquires, whether it is true that the Memphis sewerage system, as originally proposed by Col. Geo. E. Waring, has been almost entirely reconstructed, and in an appended note you ask that engineers, who have examined the Memphis sewers and criticised them privately or publicly, should state the facts on which their remarks are based. In a subsequent issue appears a letter from G. W. Pearsons, C. E., in which he gives the results of his recent examination. Perhaps still another statement in response to your request may be of interest to your readers.

Last summer I had the pleasure of examining the above works. From a careful personal inspection of the different parts and from conversations with the gentlemen immediately in charge, who were thoroughly conversant with the actual condition and operation of the system and who very kindly imparted to me all desired information, I believe that I received a very fair impression. Certain glowing accounts, especially from the pen of Col. Waring, lead one to expect not only an entirely novel system in design, with marked advantages over all other existing systems, but also an automatic and most perfect operation of the same. As far as I could learn, no one who had before visited that city, had also made an extended personal examination of the sewerage works of other countries, except, perhaps, the patentee, Col. Waring. It is therefore not at all surprising that the claim of novelty has been quite generally accepted and the successful working of the system attributed to some new idea. Any one, however, who has seen the separate sewerage system, as used in England since 1852, will not discover any novelty in Memphis, except in quite unessential details; nor will he find that these sewers operate any better and accomplish their object with greater success than others of the same kind and built previously.

Waring's patented claims, which it is commonly supposed are represented by the Memphis system, consist in the main of a combination of the following four elements: *Absolute* exclusion of all rainwater, ventilation of street sewers through house pipes, automatic flush-tanks at the upper end of every sewer and drain tiles for sub-soil drainage laid in the same trench with the sewers. All these features, separately present nothing new, but it is believed that this particular combination was never executed before. If we listen to the experience of English Municipal Engineers, or read their discussions during the last ten years, we are given abundant and good reasons why it was never generally carried out. The *absolute* exclusion of rain water, at least as far as the roof water is concerned, is considered by them to be a detriment rather than a benefit, and is avoided where practicable.

Memphis, as I learned, has independently shown the same experience. In spite of the strictest regulations guarding against the entrance of any rain water, owing to the smallness of the pipes, the owners of some houses manage to turn either roof or yard water into them to an extent which increases their flow very materially during rains and has compelled the building of special overflows from the sewers into the creek or bayou, in order to relieve them during such rains—a common custom in England.

Stoppages have occurred to an extent which made it necessary to build manholes every few hundred feet along the lines likewise as generally recommended in England, but which Waring pronounced unnecessary. In two cases the city was even compelled to build catch-basins along the line to prevent a constant silting up of the sewers from the washing of certain stables.

No other essential alterations have to my knowledge been made. But these are sufficient to stamp the Memphis sewerage works as no longer being a type of the patented "Waring System,", but rather of the English system, as nearly as could be expected of such works, which hardly ever encounter exactly the same conditions. The difference between the two systems at the outset is in fact almost infinitesimal. If the rain water from even a single roof is admitted into the so-called "Waring System," its patented charm is at once broken.

It would appear, from the foregoing that there are enough reasons why the patent was never pushed for adoption in England, but only on the Continent, where the separate system had not yet been built in any town.

While I consider the automatic flush-tanks excellent contrivances and have often recommended them, I do not think it is well to rely on them entirely or to use them everywhere. English engineers do not altogether depend on them and the experience in Memphis I think likewise confirms the wisdom of this course. One person was engaged for the exclusive purpose of looking after the 184 tanks, of which he inspected 50 every day and regularly found several out of order. He might as well have been employed to flush the sewers by drawing stoppers at the end manholes previously allowed to fill with water as usual in England, and thus have witnessed the action and at once been informed as to the condition of the sewer. The Memphis tanks each hold 112 gallons and discharging about once every 12 to 15 hours daily deliver about 40,000 gallons of water from the city supply mains into the sewers. While this quantity and the same frequency of flushing hardly seems necessary in any well devised work, it might become a formidable item in systems which require the sewage to be raised by pumping. Flushing by hand at less frequent intervals, say once or twice a week, would I think be often enough and generally more effective and less expensive. As the automatic tanks and house drainage restrictions have not prevented occasional stoppages in Memphis, the local engineers have been obliged to use various mechanical means for cleaning, precisely as in England. As the sizes are generally smaller and the benefit of flushing the mains by a simultaneous entrance of roof water is less in degree than in England, the necessity of mechanical cleaning becomes more frequent than in systems designed on a more liberal basis.

The present operations of the Memphis system, while it is as good as any city or town suitable for its application, could wish it to be, is yet no better than it would have been, had it received its true name at once, and from the start been built in exact conformity with English practice. Had not the manholes and the overflows been added, the system would on the contrary have given a good deal of trouble. The present successful operation is in my opinion not due to any novel features, but rather to their subsequent abandonment and to the careful and intelligent management of the works at the hands of Mr. Meriwether, City Engineer, Mr. A. Ross, the Superintendent and Mr. Fisher, the General Foreman of the sewers. R. HERING.

Bronze Made Malleable With Mercury.

M. Dronier, of Paris, proposes the following method of obtaining a malleable bronze:

The composition, as prepared by him, is composed of 90 parts copper and 10 parts of tin. It is rendered ductile and malleable by the addition of one per cent. of mercury in the crucible.

The bronze, with the mercury added, is cooled in sheets 19/10 in. by 8 in., by about ¼ in. thick. These plates were then beaten or rolled out cold, being annealed a number of times during this operation; thus, to reduce from a thickness of ¼ inch to 1/15 of an inch requires that the plates shall be put into the furnace five times; to reduce to 1/20 of an inch will require six to seven annealings.

These sheets reduced to the desired thickness, can be used in the manufacture of a variety of objects such as lamps, cups, plates, etc. It welds easily, takes a fine polish and can be drawn out into very fine wire.

M. Dronier says that by analysis he finds ½ of one per cent. of mercury in the manufactured, bronze so intimately united that it will not separate at any temperature.

Kirkaldy of London and Thomasset of Paris, have tested this new bronze, with results showing that the tenacity is superior to that of wrought-iron of good quality.

The price of this bronze is 3 fr. 50 per kilogramme in sheets ½ millimetre thick. In ingots the Dronier bronze is worth 3 fr. per kilogramme.—*Moniteur Industriel.*

NEWS OF THE WEEK.

Contracting Miscellany.

Two millions of dollars are to be invested in a court house at Pittsburg, Pa.

THE Massachusetts House of Assembly has adopted an order, introduced by Mr. Gove, of Boston, instructing the Committee on Cities to consider the expediency of the creation of a Board of Works, which shall take charge of and manage the affairs of any or all the departments of the city of Boston.

PUBLIC BUILDINGS, ETC.

Bills have been introduced during the past week for the erection of public buildings, etc., at the following places:

Marine hospital at Pensacola, Fla.
Post office at Houston, Tex.
Leavenworth, Kas.
Manchester, N. H.
Saratoga, N. Y.
Statesville, N. C.
Bois City, Idaho.

BRIDGES.

Bills have been introduced for the following:

Across the Missouri River at or near Decatur, Burnt Co., Nebraska.

Across the Potomac River at the Three Sisters.

PUBLIC WORKS, ETC.

Bills have been introduced for following:

Construction of ship canal around Niagara Falls.

To provide for aid in the construction and to regulate the operation of a ship canal between Lake Union and Washington and Puget Sound, in Washington Territory.

To authorize the extension of the Chesapeake and Ohio Railroad to a point on the military lands of Fortress Monroe, Va.

Improvement of Lime Kiln Crossing in the Detroit River.

Immediate appropriations for continuing work on the important river and harbor improvements.

For the permanent improvement of the Erie canal.

MISCELLANEOUS.

Bill for the erection of a bronze statue to Simon Bolivar, in Washington or New York.

Bill for the Secretary of the Navy to purchase the right to make and use a certain improvement in machines for binding metal links, and to provide for the payment thereof.

To encourage the building of American iron and steel steamers.

For artesian wells on the public lands of New Mexico.

UTICA proposes to enlarge the advanced School building at a cost of about $20,000. Of this $1,400 is for additional land and $18,600 for building and furniture. The plan contemplates the removal of the partitions from the recitation rooms, thus extending the present study rooms to the rear walls of the building, in the rear of the present building erect a three-story addition 90x30 feet; each story to be divided into five recitation rooms 16x30 feet and a cloak room 10x30 feet. In the rear of this addition and as a part of it, to erect a tower 22x29 feet in area. In this tower build a broad stairway from the ground to each story of the building, stairs to be 6 feet wide with three square landings to each story; also on the side of the town facing Charlotte Street, there is to be a room 8 feet by 20 feet fitted up and furnished in all respects for a teacher's cloak room. The basement of this addition to be properly finished and furnished for a girls' exercise room.

Estimate exclusive of furniture is summarized as follows:

Excavation, brick, stone, and mason work	$7,805.00
Carpenter's materials and work	5,879.00
Trimming, painting and glazing	970.00
Plumbing	300.00
Heating	1,500.00
Total	$16,454.00

Bridges.

THE Chippewa River Bridge Company of Durand, Wis., capital stock $25,000, has been incorporated.

OTTAWA, Ont., Jan. 9.—The Chief Engineer of Oanals having reported that all tenders for the St. Lawrence Canal improvements were far too low, the Government will call for new tenders and all deposits will be withdrawn. The lowest tender for the Williamsburg Canal was $86,000. while the engineer's estimate is $400,000.

THE Troy *Times*, in an editorial upon the Storm King Bridge, which proposes to bridge the Hudson below Newburg, states that whatever may be Mr. Swan's opinion or that of ex-Lieut. Gov. Dorsheimer or any other lawyer in the employ of the Company, the truth is that the Company has never been given the right it claims to possess. The fact that so recently as last year a strenuous but unsuccessful effort was made to secure the passage through the Legislature of a bill authorizing the construction of the bridge, shows that up to that time the Company did not regard itself as entitled to the right which it now claims.

THE plan for the new bridge of the Ottawa, Waddington & New York Railroad over the St. Lawrence River from Ogden's Island to Goose Neck Island, is now before the Privy Council at Ottawa for approval. There are good ground for the belief that the plan will be accepted. At the new site for the structure the current is neither so speedy or tortuous as the site first selected by the engineers. Waddington will be accommodated with a high level (61 feet) bridge and a swing bridge likewise, in connection with the twenty mile branch south side of the St. Lawrence, to connect at Canton with the American system of railways, and of which the construction will be commenced in the near future, as the necessary deposit has been made at Albany.

Streets, Drainage, Sewerage, Etc.

CITY Engineer Wightman, of Boston, says that the machinery connected with the improved sewerage system is working well, and that more than 10,000,000 gallons of sewerage is being discharged daily.

THE Committee on Boston Improved Sewerage, opened proposals for the erection of a pump at the east shaft. City Engineer, Henry M. Wightman's estimate for the work was $21,150. The bids were as follows: Builders' Iron Foundry, Providence, R. I., $17,990; Atlantic Works, East Boston, $22,800; Dixon Manufacturing Company of Scranton, Pa., $23,953; Boston Machine Manufacturing Company, $24,400. The work was awarded to the Builders' Iron Foundry of Providence, R. I.

Water, Gas and Steam.

ON Friday, the 11th inst., the Board of Supervisors of Ingham county, Mich., granted the right to J. M. Hammond, to erect another dam across Grand River in Lansing, some three miles above the old one.

WORK on the artesian well at Colorado Springs is to be stopped, for the reason that the city cannot afford this year to continue the experiment further.

WHERE a municipal corporation gave express permission to an individual to open a ditch across the city in order to connect the water pipes of a private person with the water-works belonging to the city, the Supreme Court of Georgia held that the opening of the ditch was, in effect, the act of the city itself, and that the latter became liable for any damage which might accrue to any person by reason of the careless and negligent manner in which the work was done. The court said that it was the duty of the city to have superintended and overlooked the work which it permitted to be done on its streets, and to have seen that it was done in such a manner that no injury should come to persons on the streets from defects therein. Mayor, etc., of Savannah, vs. Donnelly, decided on the 21st ult.—*Bradstreets.*

THE new water works of Council Bluffs, Ia., were officially and most successfully tested on Jan. 17. Six solid streams were thrown at one time from the hydrants, under a pressure of 120 lbs. at the pumps, and to a measured height of 105 feet. The engineer designing the works, was Mr. H. Birkinbine, of Philadelphia; the pumps are from the Knowles' works, Boston; about 23 miles of distribution and forcing mains are in use.

THE contract for building water works in Canandaigua, N. Y., has been given by the Canandaigua Water Works Co., to Hinds, Moffett & Co., of Watertown, N. Y. The supply is to be taken from the Canandaigua Lake, 2,000 feet from shore and pumped by steam through seven miles of pipes from fourteen to four inches diameter.

M. DEPSCHER, representing Mr. John Pender, President of the Eastern Telegraph Co. has concluded with the French Government, an arrangement for the laying of a sub-marine cable between Saigon and Tonkin. The work is to cost $600,000, and to be finished in one month from the signing of the contract.

MAJ. B. M. HARROD, of the Miss. River Commission, in speaking of the proposition to close the mouth of the Red River and divert that stream into the Atchafalaya and thence to the Gulf; says, that the Commission have not yet had time to sufficiently investigate this important problem. Nothing will be done in that direction during the present session of Congress.

FRANKLIN AND MARSHALL College, of Lancaster, Pa., is to have an astronomical observatory. Mrs. James M. Hood, of Frederick, Md., has offered to the Trustees of the college, $10,000 for the purpose named, and a building is to be erected.

MR. W. HAVENS, of Paterson, N. J., has a curious invention for converting any locomotive into a steam fire engine, for use on the line of the road, at stations, bridges, etc. The attachments are said to be simple and inexpensive. The stream is thrown from the tank of the tender, and in experiments made, a 2 in. hose and a ½ in. nozzle threw a solid stream 60 to 70 ft. horizontally and 40 ft. high. It has been satisfactorily tested for some months on the Erie and Lehigh Valley railroads.

Railroads and Canals.

THE matter of the treatment of laboring men by the authorities of the Souris & Rocky Mountain Railway is to be made the subject of a Parliamentary investigation.

OTTAWA, Jan. 15—Application will be made to Parliament for an Act to incorporate a company to construct a tunnel under the St. Clair River for railway purposes, from Sarnia to Port Huron.

OFFICERS of the Minneapolis & Sault Ste. Marie Railway Company state positively that there are no new developments in connection with the enterprise beyond the arrangements for the construction of 100 miles this year.

THE management of the Milwaukee, Lake Shore & Western Railroad Company next season will build eighty-five miles of new road and several short branches through the Agogebic iron country. The main extension will carry the road to Sunday Lake in the northern part of the State.

AMERICAN Dredge, No. 2, at Panama, has been totally destroyed. Loss, $150,000. The fire is supposed to have been of incendiary origin. The indirect loss to the canal company is considerable.

It is said that fourteen thousand men are now at work upon the Panama Canal. The dry season has set in, and hopes are entertained that much progress will be made this year.

BROWNSVILLE, Kan., Jan. 18.—The corps of surveyors who have been at work for some weeks in this vicinity, and presumably on the scheme of a short line between St. Louis and Kansas City, returned here from Arrow Rock, at which point the line crosses the Missouri River. It is not known in whose interest the survey is being made, but it is thought the Atchison, Topeka & Santa Fe Railroad. This route would be forty miles shorter, and it is claimed that a better grade than either of the lines between Kansas City and St. Louis.

STEPS are being taken to let the contract for the construction of the Cascade line between Ainsworth, a point on the main line of the Northern Pacific to Tacoma, on the Puget Sound—that portion of the line west of Ainsworth to the foot of the Cascade Mountains, about eighty-five miles, will be let inside of 30 days. It is intended to let the balance as soon as the surveyors make the location of the line through the Natchez Pass.

THE surveying of the Franklin and Magantic Railroad, running from Strong to Kingfield, Me., is well under way, and the engineers pronounce the route, sofar as surveyed, very easy, being straight and level.

THE canal from the Baltic to the North Sea, now talked of, will leave the river Elbe at a point between Brunsbuttel and St. Marguerite, will pass by Rendsbourg, and open into the bay of Kiel, at Heltenau, to the South of the great forts at Friedrichsort. Its length will be 54 miles, its depth 29½ feet at low tide, and its width 361 feet.—*Moniteur Industriel.*

FOR the last five years the railways of Italy have been managed by the State, and with the most deplorable results. As a consequence the lines of upper Italy alone will require an expenditure of about $11,000,000 at once for the purchase of rolling stock. There is now needed to meet the regular service, 287 locomotives, 668 passenger coaches and 6,163 goods wagons.—*Moniteur Industriel.*

THE impresssion prevails in Montreal that the Government will grant new terms for the completion of the Canadian Pacific Railroad Company's lines. The arrangement by which it is proposed to substitute a cash subsidy for the previous 25,000,000 acres land grant will be announced in Parliament. Most of the stock is held by foreign capitalists, and very little is in New York.

COLONEL GREENE, the railroad contractor, says that it is his purpose to get the Shore Line through to Calais, Me., there to connect with the Grand Southern and thus make a new route to St. John. He thinks the country through which it would pass would provide plenty of business, and that the distance of about ninety miles could be built for $2,000,000 or less. The new survey is progressing favorably.

INDIANAPOLIS, Ind., Jan. 15. The Bluffton & Logansport Railroad Company to-day filed an article of incorporation. The line is projected between the State line, Adams County, and Logansport, a distance of eighty-five miles. Capital stock, $100,000. The right of way from Wheeling to Lafayette has been granted, and construction, it is said, will begin in the spring.

ARTICLES of incorporation of the Grand Fork, Croopston & Lake Superior Railway Company have been filed in St. Paul. The proposed line is to run from the west bank of the Red River, at or near the mouth of Red Lake River, in Polk County, by way of the city of Crookston to the head of Lake Superior, or to a point of connection with some other road now built, or hereafter to be built. The company also proposes to build branches from Grand Forks to near the confluence of Red Lake and Wild Rice rivers, and several other branches.

CHARLESTON, S. C., Jan. 23.—Ex-Gov. Hagood, of South Carolina, President of the Carolina, Cumberland Gap & Chicago Railway Company, has given his views as to the prospects of this great enterprise, and is hopeful that arrangements will be made by which it can be completed. This road has been surveyed along its entire proposed route, which extends from Aikens, S. C., to London, Ky., a distance of more than 400 miles in almost an air line. The company has determined to raise money enough to finish the grading and to trestle and cross-tie the road from Aiken to the mountains by securing the subscriptions of towns, townships, and counties interested in the road, to the capital stock of the company. These subscriptions will be made by a popular vote and will be collected by special taxation.

NEW HAVEN, Jan. 23.—The projectors of the New York and Connecticut Air Line, one of the parallel railroads, announced that they have given out the contracts for the building of their road from the New York State line at Greenwich to New Haven. The company, under the general railroad law, has until March 24 to begin construction, by which time it must pay in $23,970 or forfeit its corporate existence. S. E. Olmstead, of Norwalk, President of the road, says that before the close of the present week ground will be broken at several points along the line of the parallel. The railroad men of the State are now forced to admit that it really looks as if a road parallel to New York, New Haven and Hartford, and running between New York and Boston was at last to be built. Associated with Mr. Olmstead are Henry R. Parrott, a varnish manufacturer of Bridgeport, and ex-Gov. William T. Minor, of Stamford, but it is generally supposed that New York capitalists are back of those gentlemen and will furnish the money by which the road will be built, if built it ever is.

NEW ORLEANS, La., Jan. 9.—Work on the New Orleans Elevated Railroad will commence next week under the management of President De Funiak, and will require two years to complete. Work will commence at the Northeastern Railroad depot, in the third district. The route will be run up the levee, along the river bank to the elevator. The foundations are to be built of creosoted piles in beds of concrete. The track will be 18 feet high and the iron columns forty feet apart, The company has a guarantee of all the financial assistance necessary for the completion of the work.

THE Providence, R. I. city council have adopted a plan by which the city and the railroads jointly are to fill up a cove basin owned by the city, and build up a big union depot and extended terminal facilities. A sharp fight was made against the scheme in its present form on the ground that it gave the New York, Providence and Boston Road privileges to the exclusion of the New York and New England and future roads. The cost is to be about $3,000,000, and the plan provides for new passenger and freight stations for all roads entering the city except the Bristol.

THE Macon and Florida Air Line Railroad Company has been organized in Macon, Ga., with A. J. Lane, as President. A surveying party began its labors on Jan. 21. The road is to be narrow gauge. It will run from Macon, Ga., due south 270 miles through the finest untouched body of timber in the South and a rich undeveloped agricultural land, to Lake City, Fla., connecting with the extensive narrow gauge system of that State. The road will furnish a direct outlet and the shortest route for Northern and Western freight. The estimated cost of the road is $8.000 a mile. It will undoubtedly be rapidly pushed forward to completion.

DANBURY, Conn., Jan 21.—The contract for the New York, Danbury and Boston Railway has been signed and is in the hands of Capt. S. M. Sullivan, the original contractor of the road who at ten years ago graded one-third its length. It is said work in the cuts will be commenced this winter. The name of "Port Chester and Ridgefield" has been dropped and that of the "New York, Danbury and Boston" substituted. The route as now projected will connect at Bronxville with the Second Avenue Railway, pass under the arched bridge of the New York, New Haven and Hartford Railroad at Port Chester, strikes the old grade of the Port Chester and Ridgefield Road a mile northeast of Port Chester station, follow this with very slight changes to Ridgefield, and thence, by a new survey, to Danbury, where it is proposed to connect with the New England Road to Boston. The total distance as surveyed is a fraction less than 65 miles.

In Colorado the Union Pacific is branching out in all directions. The South Park division, thirty-five miles, from Dillon to Leadville, was built under strong opposition from the Denver & Rio Grande, and it was found necessary many times to keep armed men on guard, and occupy the track with loaded trains as fast as laid in order to prevent it being torn up. In the Valley of the Arkansas a connecting link between the Gunnison Branch and the main line has been constructed, running from Nathrop to Buena Vista. Also, nine miles on the Boulder Branch of the Colorado Central, and some six miles at Georgetown, on the Union Pacific & Colorado.

With the exception of the extension from Lincoln to Beatrice, twenty miles, and one from Genoa to Fullerton, fourteen miles, there was but little work done by the Union Pacific in Nebraska in 1883. The Beatrice extension referred to is a part of the cross road which is to tap the Kansas Pacific at Manhattan, crossing the Kansas Central at Garrison.

MANAGER KIMBALL of the Union Pacific, reports the construction of 375½ miles of new road by his company in 1883, at a cost, in round figures, of $5,600,000. The most important work was the building of 264 miles of the Oregon Short Line, making 597 miles now completed and carrying the road well into Oregon. With the exception of the Wood River Branch from Shoshone to Hailey, 56 miles, no attempt has been made as yet to develop the tributary country, all efforts being directed to pushing forward the main line. The junction of the Oregon Short Line and Oregon Railway and Navigation Company will be at Huntington, Oregon, to which point it was understood that both lines would be completed in December last. Under Villard's management, however, the construction forces of the Railway and Navigation Company were set to work on the Northern Pacific, and the former line is badly behind. Awaiting connection with the Oregon Railway and Navigation Company, the Union Pacific is forwarding freight and passengers to Portland, via the Utah Northern and Northern Pacific, transfers to the latter being made at Garrison.

THE Bogota City Railway Co. has been organized in New York to construct steam and horse railways in the City of Bogota, United States of Colombia. The contract provides that it shall extend its lines to the towns and villages in the neighborhood of the capital.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, Jan. 24, 1884.

The eastern Pennsylvania Pig Iron market is quiet and steady. The only important improvement has been in Forge Iron for mill purposes, in order to make up deficient stocks, but these transactions were possible at concessions from asking prices, which are $18@$18.50. Mill men decline to buy more than two or three weeks ahead, although they are very short of stocks. Foundry quotations are $20@$21.50 for No. 1. Manufactured iron is dull. There are a good many inquiries floating around, but very little business is done. The disposition is to wait until after February 1st, until a greater pressure is felt for supplies. Only small lots of Steel Rails are selling, and $35 is the nominal price. Rail makers do not expect any great activity for a month or six weeks to come, because of the fact that they are well sold up, and are asking $35, while buyers expect to secure spring and summer stocks at December prices. Several small lots of old rails, scrap, crop ends, etc., have sold this week at prices ranging from $22.50 for old rails, to $23 for scrap; crop ends are $19.50@$20. Only small lots of Merchant Iron have been bought; jobbing lots are moving at $2.40@$2.50. Schemes are being pushed for the construction of elevated railroads, and it is probable that they will take shape in time to be felt by the trade this year.

PITTSBURGH, Jan. 24, 1884.

Iron quotations are $18@$21 for Foundry, according to quality; Forge, $17@$18; a few small lots of Bessemer have sold at $21. Small lots of Rails are held at $36, but average prices for large lots range from $34@$35.50. Old Rails are wanted at $22.50, but $23.50@$24 is asked. No. 1 Wrought Scrap, $20@$21; Merchant Bar is moving in small lots at 1.70@1.80. Nails, $2.40. The market, generally, is dull; because of the backwardness of large buyers in placing their orders, it is not possible to say what will be the character of February business, but the fact that stocks in consumers hands are unusually low, leads manufacturers and brokers to expect active business. The situation of the Window Glass workers is unchanged and stocks are light; the supply from the East is not sufficient to fill requirements, and foreign stocks arrive very slowly. The coal trade is dull; a good many mines are being worked by way of preparation for the spring trade.

CHICAGO, Jan. 23, 1884.

Our western markets show more improvement than eastern centres; stocks are lighter here, and we are remote from sources of supply. The demand for Manufactured Iron is particularly active, but is confined to small lots. Refined, ranges from 2c@2.10; common, 1.10, all in small lots. Demand for all kinds of galvanized and sheet-iron is also improving; Juniata is 45 per cent. off. Foreign Irons are dull. Only small lots of Nails are moving, and consumers cannot be induced to buy at present prices. Car load lots are held at $2.55@$2.60. The past week has been very dull in Tin and Tin Plate. Five ton lots of Pig Tin are selling at 20c. Mexican Tin is arriving from the Durango region. Ingot Copper is held at 14¼. All kinds of Steel show a little firmer tendency. Pig Lead, $3.90@$4. Steel Rails, $34@$36, according to size of order. Several good contracts have been placed. Business in Pig Iron is restricted to small lots, and Lake Superior irons are in most request. A great deal of Southern iron has been contracted for, and within the past three weeks prices have advanced 50c. per ton. Hardware men are beginning to push out for the spring trade. Very little has been done in Railway Material, but active business is likely, in view of the heavy construction to be undertaken as soon as spring opens.

COAL.

PHILADELPHIA, Jan. 24, 1884.

The Anthracite coal trade has been quietly improving during the past week or two under the influence of restriction, cold weather, light stocks, and improving demand. The probabilities seem more strongly in favor of an increasing manufacturing demand for February, and if this is realized, it will contribute materially to the improvement in prices which has already shown itself in advance of 10@25c. per ton on some of the smaller sizes, which sizes are scarce in the local and line trade. The larger sizes are still abundant, but not sufficiently so to depress prices. Broken and egg are being called for little more freely than two weeks ago. Freights are still high, but when the weather permits, large shipments will be made to northeastern and southern ports. To-day's advices from Chicago show a steady diminution of stocks and a readiness of buyers to place orders early next month. The Bituminous trade is still in a very dejected condition, and there is no prospect of improvement. Several large contracts will, as usual, be placed next month, but the prices will be very low. Very sharp competition will be developed between the Clearfield and Cumberland coals.